SCIENCE

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THE MEETINGS OF THE AMERICAN AND BRITISH ASSOCIATIONS FOR THE ADVANCEMENT OF SCIENCE.

THE current progress of science and the activity of scientific thought in the civilization of the present day have been signalized in a noteworthy manner by the meetings of the American and British Associations for the Advancement of Science, and of kindred societies, held recently at Detroit and Toronto. As might have been expected, the meeting of the American Association at Detroit and that of the British Association at Toronto both fell somewhat short of the average numbers in attendance; but, on the other hand, both meetings were above the average in the number and quality of the addresses and papers presented and in the enthusiastic interest of the participants. The meetings of the affiliated societies were marked likewise by the high order of the papers read and by the profound interest of the discussions and conferences of the members and foreign guests in attendance. To one present at these meetings and cognizant of the zeal, fidelity and good cheer of the delegates assembled, it would hardly appear that scientific men are seriously disturbed by those publicists who think that science will soon overreach itself, if it has not already fallen into 'bankruptcy.' Nor could one who heard a number of the scholarly addresses delivered at these meetings, addresses remarkable for their literary finish as well as for the value of their contents, entertain the scholastic fear that the perfume of the

Attic violet is likely to be stifled by the mephitic odors of the laboratory.

The sessions of the American Association at Detroit were held during the week beginning August 9th, under the favorable auspices presented by a beautiful city and by the admirable facilities of the Detroit Central High School. The ample accommodations of this building, the generous hospitality of the citizens of Detroit, and the assiduous labors of the local committee, afforded an ideal environment, and one to which the Association will doubtless be pleased to return in due time.

Owing to the death of Professsr E. D. Cope, the duties of the retiring President fell upon Dr. Theodore Gill; while the absence, by reason of illness, of the President-elect, Professor Wolcott Gibbs, threw the labors of the presidency of the Detroit meeting on the next senior Vice-President, Dr. W J McGee. It was commonly and justly remarked that the fidelity and ability with which Dr. Gill and Dr. McGee executed the arduous trusts thus unexpectedly brought upon them contributed in a most marked degree to the success of the meeting.

The opening session of the Association was held in the spacious auditorium of the high school and proceeded with the usual invocation and addresses of welcome from representatives of the city. Perhaps there is still need of this formula in introducing to a community a national scientific organization whose work and aims are but little known. But its use sometimes leads to inconsistencies and absurdities which are very depressing to men of science. The invocations are not infrequently tantamount to an apology for the existence and to a plea for the toleration (within due limits) of science which are at once needless and undignified; while the labored efforts of unscientific men to welcome science as the 'handmaid of religion' are often painful episodes in an otherwise pleasant greeting.

In spite of the small attendance the meeting must be regarded as one of the most successful in the history of the Association. This happy outcome may be ascribed to a number of causes. Among these may be mentioned the carefully prearranged programs of the sectional committees; the continuity of the meetings, which now run from Monday to Friday without interruption by excursions, etc.; the joint meetings of Sections C and E with the American Chemical Society and with the Geological Society of America, respectively; and the accessions of fresh enthusiasm from the younger members of the Association. The presence and participation of a number of foreign guests added greatly also to the interest of the sessions. The presence, likewise, of a number of past Presidents of the Association was an inspiring feature which ought to be more prominent in the future than it has been in recent years.

As usual, the labors of the Council were wearisome, consuming about eighteen hours per day throughout the week, and leaving but little time for science to those charged with official duties. Some constitutional amendments whose object is to shorten and simplify the business affairs of the Association were adopted. Other changes looking

toward the same end must be considered, doubtless, in the near future, especially in connection with the question of the relations of the Association to the vigorously active affiliated societies.

The election of Professor F. W. Putman to the presidency of the Association was the highest tribute that could be paid him for his long and indefatigable labors as Permanent Secretary. The cordial unanimity of this election was fitly supplemented by the hearty acceptance of the graceful invitations of Boston to hold the semi-centennial meeting of the Association in 1898 in that city. All interested in the advancement of science in America should aim to be present at this next meeting. The Association has a great work to perform, and every friend of science should aid that work by his presence and good fellowship at the meetings even should he not contribute to the formal proceedings.

On Monday, Tuesday and Wednesday, August 16th–18th, the American Mathematical Society and the American Society for the Promotion of Engineering Education held their meetings at Toronto. The spacious accommodations of the beautiful buildings of the University of Toronto were placed at the disposal of the societies, and the University authorities, individually and collectively, were most gracefully attentive to the needs and pleasures of the delegates. The rapid growth and the productive activity of these societies—each now counting more than 200 members, and each printing 300 to 500 octavo pages of proceedings—are at once surprising and gratifying. Their history, which cannot be entered into here, is similar to that of the Geological Society of America. Their work is in many respects allied to that of the American Association for the Advancement of Science, and a closer affiliation with the latter through mutual concessions seems to be the logical and desirable outcome of existing conditions. The meetings held at Toronto were characterized by the well digested contents of the papers presented and by the clearness of exposition shown by the authors. Much interest was given to these meetings also by the presence of a number of foreign guests and members of the societies.

On the afternoon of Wednesday, August 18th, the British Association for the Advancement of Science was welcomed to the Dominion of Canada, to the Province of Ontario, and to the City of Toronto, by the Governor-General, the mayor of the city, and other officials. In these ceremonies the intense patriotism of the jubilee year and the devotion of our British cousins to the work of their Association were alike pleasantly and prominently manifest. On the following evening Sir John Evans, President-elect of the meeting, read his address, printed in a recent issue of this JOURNAL, before a large and brilliant audience. The formal addresses of the Sectional Presidents were given during the forenoon of Thursday, after which the sections proceeded to the presentation and discussion of less formal communications. Daily or more frequent sessions were held by the various sections, and the meeting continued until August 25th. The well-planned excursions and social events con-

tributed greatly to the enjoyment and profit of all.

Delegates from the United States were present in large numbers and participated in the proceedings of this meeting of the British Association. Many of them were courteously invited to sit with the sectional committees and to join them in their deliberations. The formation of new and the renewal of old acquaintanceships, and the free interchange of thought thus afforded, made the meeting seem, to quote the language of the admirable address of Sir John Evans, like a 'family gathering in which our relatives, more or less distant in blood, but still intimately connected with us by lauguage, literature and habits of thought, have spontaneously arranged to take part.'

In its management of business details the British Association presents some instructive points of contrast with our own organization. Without entering here upon a discussion of these points, it may be useful to mention three wherein the British Association appears markedly superior to the American. The first of these is the absence, at the summer meetings, of repeated and prolonged sessions of the Council, or governing body. Secondly, no sessions affording opportunity for miscellaneous debate by members in general are held. The entire energy of the members in attendance may thus be turned toward the object of the Association—the advancement of science. Thirdly, there is the advantage which comes from the greater freedom and powers of the sectional committees. These virtually control the proceedings of their respective sections at any meeting, and the work of a section goes on with the vigor and effectiveness which characterize our independent or affiliated societies. In addition to these administrative matters, one cannot help noting the greater enthusiasm of our British kin for science and for scientific men, and the larger proportion of attendance at their meetings of their best men. With them the meeting of the British Association is one of the most important events of the year. With us, widely separated over a continent, there is less opportunity for the cultivation of enthusiasm and greater difficulty in coming together; but who shall say that these are insurmountable obstacles in the way of a worthy scientific zeal and enterprise?

INTERNATIONAL AMENITIES AT DETROIT AND TORONTO.

In accordance with action taken at Buffalo last year, members of the British Association for the Advancement of Science attending the meeting of the American Association at Detroit were made honorary members of the latter body for the 1897 meeting. Perhaps a score of British and Continental scientists availed themselves of this privilege; several of them took part in the work of the Sections, joining freely in discussion and in some cases participating also in the labors of the presiding officers; and it was a general opinion that the presence of these distinguished representatives of science from over seas contributed materially to the success of the Detroit meeting. Especially noteworthy, as an indication of the comity between the two Associations, was the presence of Professor A. B. Macallum, the Local Secretary of the British Association for the Toronto meeting, who came specially to extend in person the courtesies of this body and to make arrange-

ments for transportation, etc., on behalf of Americans desiring to visit Toronto. The Detroit meeting was unexpectedly successful; it is true that the attendance was barely 300 and therefore below the average, but in number and quality of papers, in value of discussions, and in attendance at sectional meetings it ranked, in the judgment of most of the old-time members present (including four past-Presidents), as one of the best meetings in the history of the Association. The pleasure of the meeting was enhanced by exceptional local interest, displayed not only by the local committee but by the citizens generally, and also by the notably excellent press of Detroit; but a large measure of the pleasure, as well as the success, of the meeting must be ascribed to the presence of so many prominent members of the British Association.

In the opinion of old-time members, the Toronto meeting of the British Association was well above the average in number and quality of communications and in the discussions, while the attendance (about 1360), though less than the average, was fully up to expectations. To this meeting American scientists, and particularly members of the American Association, contributed freely. This participation was encouraged by the older Association in making the general and sectional officers of the American Association honorary members, and in placing members of the American body on exactly the same footing as their own members, *i. e.*, admitting them to the privileges of the Association on payment of the customary membership fee. Some 250 American scientists, including about a score of officers of the American Association, availed themselves of these privileges; of these something less than 100 went directly from Detroit, leaving fully 150 Americans, nearly all members of the American Association, who chose Toronto rather than Detroit as a place for scientific association and discussion, thereby paying the highest possible compliment to the older organization. They were made welcome in the Sections and general meetings; many of them were placed on sectional committees (which are more important in the British body than in the American), and several of them were elected to vice-presidencies; they presented numerous formal communications, joined freely in discussion, aided in administration even to the extent of actually presiding in the absence of the sectional presidents, and contributed in due measure toward shaping the scientific character of the meeting. A noteworthy feature was the attention given in the Section of Geography to a series of papers prepared expressly for this meeting by representatives of our National Geographic Society. In the general meetings and public functions special attention was shown to the American Association collectively as well as to the individual members; the officers were invited to occupy platform seats, and at the closing banquet two representatives of the American body were among the rather limited number of speakers. At this banquet, as on other occasions, the members of the two Associations had the same footing; some officers of both were guests, the list including the general officers, Vice-Presidents, and past-Presidents of the American Association. In thus extending courtesies to the younger organization of similar aims, the British Association departed considerably from its traditions and its eminently conservative custom; and it cannot be doubted that the departure must be credited in the first place to the good offices of the local committee, and in the second place to the exceptionally large common membership, growing out of the fact that in Canada the fields of the two Associations overlap.

The near conjunction of the two meetings in time and place has undoubtedly been most beneficial; it has extended individual

acquaintance between investigators pursuing related lines of research; it has made each Association better acquainted with the character and purposes of the other; it has increased mutual esteem between the men and institutions; and it strengthened both bodies in attendance and in quality and quantity of work, and has been especially beneficial in diffusing knowledge of and interest in scientific matters among the people of two countries. Some of the benefits were felt at the meetings; yet it seems fair to regard these as but the germs of greater benefits to come as the personal and collective relations begun at Detroit and Toronto mature and strengthen.

It seems specially desirable to note the international amenities characterizing the Detroit and Toronto meetings, since minor misapprehensions have come to the surface. For example, it has been alleged in the newspapers that certain members of the American Association were treated with discourtesy at the Toronto meeting. It must be evident, in view of the prevailing harmony and the unprecedented warmth of the courtesies extended by each of the Associations, that the sources of individual criticism are to be found in personal matters and not at all in general feeling. It may not be amiss to add that the Local Secretary of the British Association has explained, through the public press, that certain Americans, who complained, through the medium of associated press despatches, of discourtesy at Toronto, were not registered as members of the British Association, and therefore occupied the precise footing of the general public, which, in the British Association, is not entitled to admission to the meetings or other participation in the work of the body. The great and significant fact is that the relations between the two Associations at Detroit and Toronto were most cordial, sympathetic and beneficial; this fact assuredly overshadows any and all petty misapprehensions, and must serve to render the meetings memorable.

W J McGee.

THE SPREAD OF LAND SPECIES BY THE AGENCY OF MAN; WITH ESPECIAL REFERENCE TO INSECTS.

Among the many influences which during the last century or two have been affecting that unstable condition of life which is expressed in the words 'the geographical distribution of animals and plants' none has approached in potency the agency of man exerted both purposely and unwittingly or accidentally.

Natural spread was for centuries the rule. Species dispersed under natural conditions along the line of least resistance. Winged animals and seeds were spread by flight and by the agency of winds, and at their stopping places thrived or did not thrive according as conditions were suitable or not suitable. Aquatic animals and plants and small land animals and plants were distributed by the action of rivers and streams and by the ocean itself. Wonderful migrations have occurred, commonly with birds, more rarely with other animals; ice floes and driftwood have carried animals and plants far from their original habitats and even volcanic action has taken part in the dispersal of species. Smaller animals, especially mollusks and insects, and the seeds of plants have been carried many hundreds of miles by birds and lesser distances by mammals.

With the improvement of commercial intercourse between nations by land and by sea another factor became more and more prominent, until in the present period of the world's history the agency of man in the spread of species, taking all plant and animal life into consideration, has become the predominating one. Potentially cosmopolitan forms, possibly even insular in-

digenes, have by this important agency become dispersed over nearly all of the civilized parts of the globe, while thousands of other species have been carried thousands of miles from their native homes, and have established themselves and flourished, often with a new vigor, in a new soil and with a novel environment.

It is obvious that this agency is readily separable into two divisions: *a*, intentional; *b*, accidental.

a. Intentional Importations. Since early times strange plants and animals have been carried home by travelers. Conquering armies have brought back with the spoils of conquest new and interesting creatures and useful and strange plants. With the discovery of America and with the era of circumnavigation of the globe such introductions into Europe of curious and useful species, plants in particular, increased many fold, while with the colonization of America and other new regions by Europeans there were many intentional return introductions of Old World species conducive to the welfare or pleasure of the colonists. Activity in this direction has been increasing and increasing. Public botanical gardens and many wealthy individuals in all quarters of the globe have hardly left a stone unturned in their efforts to introduce and acclimatize new plants, particularly those of economic importance and æsthetic quality, not failing occasionally, it must parenthetically be said, to establish some noxious weed, or some especially injurious insect; while it is safe to say that probably the majority of the desirable plants of Europe which will grow in the United States have already been introduced, and that there has been an almost corresponding degree of activity in the introduction of desirable plants from the United States into Europe. In all this host of valuable introductions there have been comparatively few which have turned out badly, aside from failures of establishment. The wild garlic (*Allium vineale*), that ubiquitous plant which gives its taste to milk, butter, and even to beef during the spring and summer months in many of our States, is said to have been intentionally introduced by the early residents of Germantown, Pennsylvania. The water hyacinth (*Piaropus crassipes*), originally grown for ornament in a pond near Palatka, Florida, escaped into the Saint John's river about 1890, and has multiplied to such an extent as to seriously retard navigation and to necessitate government investigation. The distribution of the orange hawk-weed (*Hieracium aurantiacum*), a dangerous species which has ruined hundreds of acres of pasture land in New York of recent years, was originally aided by a florist as a hardy ornamental plant. The European woad-waxen (*Genista tinctorium*) was early introduced at Salem, Mass., in fact about thirty years after the settlement of the colony. It has apparently not been used as a dye plant, but for garden and ornamental purposes only. During the last few years it has become a noxious weed throughout Essex and the adjoining counties. Standing on a rock at Swampscott on July 9th, last, the writer was able to see that the country for miles around was colored a bright yellow with enormous masses of this plant. Similar instances are fortunately rare and the majority of our noxious weeds have been accidental introductions.

Intentional introductions of animals, however, have by no means resulted as advantageously as intentional introductions of plants, with the exception of the truly domesticated species, such as the horse, ass, cow, sheep, pig, dog, cat, poultry, honey bee and silk worm of commerce. Even with such species, the grazing ranges of Australia have been overrun by wild horses to such an extent that paid hunters shoot them at a small sum per head, and the European rabbit has become a much worse plague on the same island continent.

Intentional introductions of wild species, however, have almost without exception resulted disastrously.

At various intervals between 1850 and 1867 a few pairs of English sparrows were introduced into our northeastern States to destroy canker worms, and to-day this species is an ubiquitous and unmitigated pest throughout all the austral and transition regions of North America, finding its limit only at the borders of the boreal zone, while the place of the injurious insect it was imported to destroy has been taken by another and worse insect pest which it will not touch.

In 1872 Mr. W. Bancroft Espeut imported four pairs of the Indian mongoos from Calcutta into Jamaica for the purpose of destroying the 'cane-piece rat.' Ten years later it was estimated that the saving to the colony through the work of this animal amounted to £100,000 annually. Then came a sudden change in the aspect of affairs. It was found that the mongoos destroyed all ground-nesting birds, and that the poultry as well as the insectivorous reptiles and batrachians of the island were being exterminated by it. Injurious insects increased in consequence a thousand fold; the temporary benefits of the introduction were speedily wiped away, and the mongoos became a pest. Domestic animals, including young pigs, kids, lambs, newly-dropped calves, puppies and kittens were destroyed by it, while it also ate ripe bananas, pine apples, young corn, avocado pears, sweet potatoes, cocoas, yams, peas, sugar cane, meat and salt provisions and fish. Now, we are told, nature has made another effort to restore the balance. With the increase of insects due to the destruction by the mongooses of their destroyers has come an increase of ticks which are destroying the mongoos and all Jamaicans rejoice.

The flying foxes of Australia (*Pteropus* sp.) are animals which are very destructive to fruit in their native home. Frequently some well-meaning but misguided person will arrive on a steamer at San Francisco with one or more of those creatures as pets. While it is not probable that any of the flying foxes will thrive in northern California or in fact in Austral regions, the experience is too dangerous a one to try, and the quarantine officer of the California State Board of Horticulture has always destroyed such assisted immigrants without mercy.

Less than thirty years ago (in 1868 or 1869) Professor Trouvelot imported the eggs of the gypsy moth (*Porthetria dispar*) into Massachusetts. The insect escaped from confinement, increased in numbers, slowly at first, more rapidly afterwards, until in 1889 it attracted more than local attention, with the result that in 1890 the State began remedial work. This work has steadily progressed since that time and the State has already expended something over a half million of dollars in the effort to exterminate the insect, and it is estimated that one million five hundred and seventy-five thousand dollars more must be used before extermination can be effected.

Contrast with this a single intentional importation which has had beneficial results. The Australian ladybird (*Vedalia cardinalis*) was introduced into California in 1889 with the result of saving the whole citrus growing industry of the State from approaching extinction through the ravages of the cottony-cushion scale (*Icerya purchasi*). Later importations of the same insect into South Africa and Egypt also resulted beneficially.

We have thus had sufficient experience with intentional importations to enable us to conclude that while they may often be beneficial in a high degree they form a very dangerous class of experiments and should never be undertaken without the fullest understanding of the life history and

habits of the species. Even then there may be danger, as with a new environment habits frequently change in a marked degree.

b. Accidental introductions. The agency of man, however, has been more potent in extending the range of species and in changing the character of the faunas and floras of the regions which he inhabits by means of accidental importations.

The era of accidental importations began with the beginning of commerce and has grown with the growth of commerce. The vast extensions of international trade of recent years, every improvement in rapidity of travel and in safety of carriage of goods of all kinds, have increased the opportunities of accidental introductions, until at the present time there is hardly a civilized country which has not, firmly established and flourishing within its territory, hundreds of species of animals and plants of foreign origin, the time and means of introduction of many of which cannot be exactly traced, while of others even the original home cannot be ascertained, so widespread has their distribution become.

These accidental importations would at first glance seem to have been more abundant with plants than with animals, since the opportunities for the carriage of seed, especially flying or burr-like seed, and especially when we consider the vitality of this form of the plant organism, are plainly manifold, but I shall later show that possibly even this obvious generalization must be modified in view of the multitudinous chances for free travel which the smaller insects have under our modern systems of transportation.

The agencies which have mainly been instrumental in the accidental distribution of plants are:

1. Wind storms. It is obvious that light flying seeds may be carried many hundreds of miles by hurricanes and may fall in new regions.

2. Water. This is a very important agency in the distribution of plants upon the same continent, but less important as affecting intracontinental distribution. Still they may be carried by this means from one island to another adjoining island, and when lodged in the crevices of the driftwood they undoubtedly travel greater distances.

3. Birds. Seeds are frequently carried great distances by birds. Many of the larger seeds will germinate after passing through the alimentary canal of a bird, and may thus be eaten at one point and voided with the excrement at a widely distant point. It has been shown, for example, that the local distribution of *Rhus toxicodendron* is greatly affected by the carriage and distribution of the seed in this way by the common crow. Smaller seeds are carried in earth on the feet of birds. Darwin's example of a wounded red-legged partridge which had adhering to its leg a ball of earth weighing $6\frac{1}{2}$ ounces, from which he raised 32 plants of about five distinct species, is an evidence of the possibilities of this agency, while his experiment with $6\frac{3}{4}$ ounces of mud from the edge of a pond which produced 537 distinct plants, an average of a seed for every 6 grains of mud, is still more conclusive.

4. Ballast. This is the first of the distribution methods which may be combined under the head of 'agency of man.' The discharge of earth ballast by vessels coming from abroad has been a notable means of distribution of plants by seed. We have just seen how many seeds may germinate from a very small lump of earth, and the possibilities in this direction of the many thousands of pounds of discharged ballast are very great. In fact the ballast grounds in the neighborhood of great cities are invariably favorite botanical collecting spots; they have usually a distinctive flora of their own, and from these centers many introduced plants spread into the surrounding country.

5. Impure seed. The great industry in the sale of seed which has grown up of late years is responsible for the spread of many plant species, principally, it must be said, undesirable species. Mr. L. H. Dewey says: "It may be safely asserted that more of our foreign weeds have come to us through impure field and garden seeds than by all other means combined."

6. The packing material of merchandise. The hay or straw used in packing crockery, glassware or other fragile merchandise is a frequent carrier of foreign seeds. Such goods frequently reach the retailer without repacking, and the hay or straw is thrown out upon the fields or used as bedding for domestic animals and carried out with the manure.

7. Nursery stock. Plants are often accidentally introduced by means of seeds, bulbs and root stocks attached to nursery stock or among the pellets of earth about the roots of nursery stock. The extraordinary development, of late years, of commerce in nursery stock has undoubtedly been responsible for the intracontinental carriage of many species of plants in this way.

Instances of the accidental spread of larger animals by man's agency are necessarily wanting. Of the smaller mammals the house rat and the house mouse have been accidentally carried in vessels to all parts of the world and have escaped and established themselves, the former practically everywhere except in boreal regions, or only in its southern borders, and the latter even as far north as the Pribyloff Islands, as I am informed by Dr. Merriam. Small reptiles and batrachians are often accidentally carried by commerce from one country to another, but although there are probably instances of establishment of such species none are known to me at the time of writing.

Land shells are often transported accidentally across the ocean in any one of the many ways in which the accidental transportation of plants and insects may be brought about, and by virtue of their remarkable power of lying dormant for many months are able to survive the longest journeys. The conditions which govern the establishment of species in this group, however, seem somewhat restrictive, whence it follows that comparatively few forms have become widespread through man's agency, although Binney mentions a number of European species which have been brought by commerce into the United States and have established themselves here, mainly in the vicinity of the seaport towns of the Atlantic coast.

With the earthworms a striking situation exists. It has been shown that, "without a single exception, the Lumbricidæ from extra-European regions are identical with those of Europe; there is not a variety known which is characteristic of a foreign country."* Careful consideration of the evidence seems to show that this is due to accidental transportation by the agency of man.

Comparatively little has been done in the study of the geographical distribution of insects. In the words of Wallace:

"The families and genera of insects are so immensely numerous, probably exceeding fiftyfold those of all other land animals, that for this cause alone it would be impossible to enter fully into their distribution. It is also quite unnecessary, because many of the groups are so liable to be transported by accidental causes that they afford no useful information for our subject, while others are so obscure and uninteresting that they have been very partially collected and studied, and are for this reason equally ineligible."

Nevertheless, the time has already arrived with some groups, and is not far distant

*F. E. Beddard, Text Book of Zoogeography, Cambridge, 1895, p. 153.

even with the others which Mr. Wallace has termed 'obscure and uninteresting,' when, owing to the indefatigable industry of entomologists as a class, important facts can be gained along distribution lines from the group of insects. Thus it is only within the past few months that the publication of Mr. W. F. Kirby's 'Catalogue of the Odonata of the World' has made it possible for Mr. G. H. Carpenter, of the Royal Dublin Society, to prepare a comprehensive paper on the geographical distribution of the dragon-flies, a group in which a comparatively few workers have interested themselves. It is in a measure true to-day, as it was entirely true when Wallace wrote, that "many of the groups are so liable to be transported by accidental causes that they afford no useful information for our subject," yet even with the group in which the greatest obscurity as to the original home of the species has existed, owing to a very easy and most frequent commercial transportation—the Coccidæ or scale-insects—the continued discovery and characterization of new forms from all parts of the world, and especially of those existing in wild regions, away from the influence of man, are gradually giving us an insight into the probable character of the original coccid faunas of more or less restricted regions.

By reason of the drawbacks mentioned, Wallace considered only "a few of the largest and most conspicuous families which have been so assiduously collected in every part of the globe and so carefully studied at home as to afford valuable materials for comparison with the vertebrate groups." These groups included 16 families of diurnal Lepidoptera and six of the families of Coleoptera. Even with this restriction among the beetles, however, he must have had some difficulties with the accidental importations, for among the beetles are hundreds of examples of this class of introductions. For example, writing later in his Island Life, the great naturalist shows that in 1880 the total number of species of beetles known in the Azores amounted to 212, of which 175 were European. Out of these, however, no less than 101 were believed to have been introduced by human agency. Concerning St. Helena he quotes Mr. Wollaston's opinion that 74 of the 203 species have certainly been introduced by the agency of man.

In considering the question as to the regions with which an interchange of forms is most likely to occur, it is obvious that they are those which have the greatest similarity of climate, and, most nearly, identity in point of time of seasons, those in fact which are most likely to afford similar environmental conditions. A study of the similarity of faunas and floras already existing will lead us to the same result. Wallace has pointed out that with the Coleoptera the best marked affinities between regions are those between the Nearctic and the Palearctic, the Oriental and Australian, the Australian and the Neotropical, all of which appear to be about equal in each case. Next comes that between the Ethiopian and the Australian on the one hand and the Ethiopian and the Neotropical on the other, which also appear about equal. Then follows that between the Nearctic and Neotropical regions, and lastly, and by far the least marked, that between the north temperate and south temperate regions.

Further, in the consideration of accidental commercial importations, the amount and frequency of commercial interchange and the rapidity of the journey are most important factors.

From all of these considerations combined we arrive at the conclusion that the regions with which accidental interchange of species should be most frequent are Europe and North America, and this is with insects to a certain extent borne out

by the facts. The introduction of species from Europe into North America is of every-day occurrence and their establishment is far from rare. The carriage of American species to Europe is an equally frequent matter, but their establishment is much less frequent.

I have studied in this connection—my profession being that of an economic entomologist—principally the species which are prominent as injurious to horticulture or agriculture or in other ways inimical to man. Listing the insects of prime economic importance in the United States, the species each of which almost annually causes a loss of hundreds of thousands of dollars, we find that they number seventy-three. Of these thirty are native, while thirty-seven species have been introduced, six species being of doubtful origin. Of the thirty-seven introduced species, thirty have come to us from Europe, all, with one exception, as accidental importations.

Of the prominent European injurious insects, on the other hand, but three are said to have come from America; the grape-vine Phylloxera (*Phylloxera vastatrix*), the woolly root-louse of the apple or 'American blight' (*Schizoneura lanigera*), and the Mediterranean flour moth (*Ephestia kuhniella*). Of these but one is certainly American—the Phylloxera. The origin of the Schizoneura is somewhat doubtful, while the Mediterranean flour moth is not American, but probably came to us from Europe, although originally it is probably Oriental.

As with these insects of prime economic importance, so it is with other less noted species. There have been rather frequent establishments of European species in America, but practically none of American species in Europe. The reason for this curious condition of affairs is difficult to find. The general trend of accidental importations seems to have been westward, and it is doubtless a fact that certain of our now cosmopolitan forms were originally Asiatic and have traveled westward, through Europe, to and across America, and thence to Hawaii, New Zealand and Australia. The existence of such a law is borne out in the study of plants as well. The statement just made regarding insects of prime economic importance is almost exactly paralleled with the plants classed as weeds. It has thus been shown that, out of two hundred American weeds, one hundred and three are introduced, of which ninety-six are from Palearctic regions, sixty-eight being native to Europe, while it seems that less than half a dozen American species have become troublesome in Europe. A number of American species, however, have been carried to Australia and flourish there with vigor.

This general trend from east to west has always been in the direction of the newer civilization—from the older civilization to the newer. That this in itself is significant cannot be doubted, and in the case of the insect and plant enemies of agriculture the facts surrounding this condition are almost in themselves sufficient to account for this directive movement. I have shown in another paper that the denser population of the older countries and the resulting vastly smaller holdings in farms, the necessarily greatly diversified crops, the frequent rotations of crops, together with the clean and close cultivation necessitated by the small size of the holdings, and the cheaper and more abundant labor, will all operate as a barrier against the establishment of injurious species, while the reversed conditions in a newer country at once liberate an introduced species from the repressive conditions which affected it in its original home and encouraged its establishment, multiplication and spread. But there are deeper causes than this at work. It has been suggested that the flora and fauna of America, the older continent, have

become degenerate through age and cannot successfully resist competition with the more vigorous forms introduced from the younger continent of Europe,* and that there are not-yet-formulated climatic differences favorable to the development of Palearctic forms on the American continent; but these theories seem insusceptible of proof, and for the present we must content ourselves to accept the facts as we find them.

The insects which are accidentally imported are carried in three main ways. Either (1) they are unnoticed or ignored passengers on or in their natural food, which is itself a subject of importation, such as nursery stock, plants, fresh or dried fruit, dried food stuffs, cloths, lumber or domestic animals; or (2) their food being the packing substances used to surround merchandise or the wood from which cases are made, they are thus brought over; or (3) they may be still more accidental passengers, having entered a vessel being loaded during the summer season, and hidden themselves away in some crevice. The coleopterists (Hamilton and Fauvel) make a distinction by name among these classes, calling the first group 'insects of commerce' and the latter 'accidental importations.'

It would appear on the face that these more strictly accidental importations must be rarer than those which are termed commercial importations, yet of the 156 introduced Coleoptera recorded by Dr. Hamilton in 1889, sixty only were considered by that writer as insects of commerce, while 96 he thought had been brought over in this accidental way.

The remaining Coleoptera common to North America and the Palearctic region, 278 in all, Dr. Hamilton considers to be practically circumpolar species, or at least not imported. Fauvel in his remarks and additions to Hamilton's catalogue raises the number of non-introduced or circumpolar species to 366, leaving 125 as imported, of which only 28 appear to have been imported from temperate Europe, the rest being cosmopolites or subcosmopolites. Of the latter class he thinks that 59 originally came from the temperate Europeo-Siberian fauna, 10 from the Oriental fauna, 15 from the Ethiopian, 4 from the Neotropical, 7 being uncertain and 2 unknown.*

It should be noted, however, that there is grave room for difference of opinion regarding a number of the European species considered by him as indigenous to North America. *Scolytus rugulosus*, *Hylastinus trifolii*, *Anthrenus scrophulariæ*, *Sitones hispidulus*, *Cryptorhynchus lapathi*, and a number of others which might be specified, have undoubtedly been imported from Europe and were quite possibly originally imported.

There are obstacles in the way of the establishment and spread of species which are imported quite by accident which usually do not exist in the case of the so-called commercial importations. In many cases, entering the vessel by accident, they exist there as single individuals, and upon liberation, even should the conditions be favorable, only gravid females could perpetuate the species. Then also the majority of such specimens are liberated, upon the unloading of the vessel, upon the wharves. The water front of a seaport city is not a favorable place for the establishment of a species which feeds on living vegetation. Frequently, even when it is a species well fitted for acclimatization, it will have to fly or be carried for miles inland before it can find a place possible for the establishment of the species. So it happens that while foreign insects are frequently found in living condition about the wharves of our

*The spread of European species in Australia has been explained by the superior energy of the younger races of the Palearctic region.

*Hamilton, in his 1894 paper, raises the number of Coleoptera common to the two countries to 594, making the number of introduced species 216.

larger seaports during the summer months, almost none have succeeded in getting a foothold in the vicinity. Mr. Otto Lugger, when living in Baltimore, Md., made a collection of many species of foreign insects found upon the wharves, yet he has recorded the establishment of but a single species, viz, *Aphodius erraticus*, an European dung-beetle, which managed to get to Druid Hill Park, where it bred in the dung of the tame deer, afterwards spreading into the surrounding country and breeding in the dung of sheep and other domestic animals.

Practically, therefore, after many years of the most active commerce, the insect faunas of the immediate vicinity of the larger seaports, like New York, Boston, Philadelphia and Baltimore, have not been greatly changed by the introduction of foreign elements.

All of the household insects and true city insects are, of course, exceptions, to this conclusion and the strong flying, vigorous, and simple living dipterous insects—the very ones most likely to enter a loading vessel and to escape on the discharge of its cargo—will many of them find proper places for breeding. It is likely that a much larger proportion of the many species of Diptera common to Europe and North America have been brought over in this accidental manner than is the case with the Coleoptera.

But often these purely accidental species are carried inland in packing cases, into the cracks of which they may have crawled, or even in the trunks of passengers, and they may then be liberated in more favorable localities. For example, Mrs. H. G. Hubbard, after spending the summer on Prince Edward's Island, returned in the autumn to Detroit, Mich., and in unpacking her trunks her husband found two specimens of *Phytonomus punctatus*, a species not previously known to occur in Michigan, although found there in injurious numbers a year or so later. It is altogether likely that the imported elm leaf-beetle (*Galerucella luteola*), an insect which enters houses for hibernating purposes, was first brought to America in this manner.

It is, however, the accidental commercial importations which theoretically stand the best chance of establishing themselves, since, in the first place, they are generally imported in or upon their natural food. In the second place, they generally occur in considerable numbers, instead of as isolated individuals, as with the more purely accidental importations; and, in the third place, they are usually carried as originally packed, far from the port of entry.

With insects brought over on plants or nursery stock the conditions could not well be much more favorable. Their supply of food is looked after with care, the host plant is soon put in the ground in the best of surroundings, and the greatest care is taken of the choice importation. Upon or in importations of this kind are carried Coccidæ in all stages of growth, and often, fortunately, their enclosed parasites, the eggs of Aphididæ, the larvæ of wood-boring Coleoptera, the eggs of many other insects, the cocoons of small Lepidoptera, and probably even in rare cases the larvæ of Lepidoptera, since it now seems likely that *Euproctis chrysorrhœa* was imported into Massachusetts on nursery stock in its larval hibernacula. The Coccidæ, however, are most abundantly carried in this way. Under natural conditions these insects have usually a rather restricted distribution, but by means of this commercial distribution many of them have become of almost world-wide range, and the end will certainly not be reached until every country possesses every species of scale insect which can possibly live in its climate. A few instances drawn from a recent paper by Mr. Cockerell will illustrate this fact:

Diaspis amygdali, or *lanatus*, was described from Australia in 1889. To-day we know it

from Australia, Ceylon, Hong Kong, Japan, several localities in the United States, Jamaica, San Domingo, Grand Cayman, Barbadoes, Martinique, Trinidad and Cape Colony.

Aulacaspis rosæ was described from Europe, but is now found also in the United States, Australia, New Zealand, the Sandwich Islands, China and Jamaica.

Chionaspis citri was described from Louisiana and Cuba in 1883 and is now known from Trinidad, Antigua, Demarara, Bermuda, Mexico, Tonga, New Zealand and Australia.

Howardia biclavis was described in 1883 from specimens on hothouse plants in Washington, D. C. Now it is known out-of-doors from Trinidad, Mexico, Tahiti, Sandwich Islands and Ceylon.

Lecanium oleæ is found in Europe, the United States, the West Indies, Mexico, Sandwich Islands, New Zealand, Australia and Cape Colony.

The hymenopterous parasites of the Coccidæ, by virtue of their mode of life, have spread almost equally with their hosts by means of this commercial transportation. I have been able to show recently that by this means a number of species of the Chalcidid subfamilies Aphelininæ and Encyrtinæ have, in comparatively recent years, become cosmopolites. For example: *Aspidiotiphagus citrinus*, originally described from California in 1891, is now found in many other portions of the United States, in the West Indies, Italy, Austria Ceylon, China, Formosa, Japan, Cape Colony, Queensland, South Australia and Hawaii. Practically the same remarkable distribution is followed by *Prospalta aurantii*, *Aphelinus mytilaspidis*, *A. diaspidis* and *A. fuscipennis*, while the remarkable and system-breaking Encyrtine—*Arrhenophagus chionaspidis*, described by Aurivillius from Swedish specimens in 1888, has since been found in Austria, Italy, several portions of the United States, Ceylon, Japan, Formosa and China.

Only second to the Coccidæ in the facility with which they are transported in this way are the Aphididæ. These insects, however, are fragile, soft-bodied and unprotected. They are readily carried, however, in the winter-egg condition and many species are rapidly becoming cosmopolitan. They have not been studied, however, elsewhere than in Europe and the United States, and the extent to which this commercial distribution has been carried can only be surmised. A suggestion of this extent, however, occurred to me when within the past few weeks specimens of *Aphelinus mali*, a common parasite of Aphididæ in Europe and North America, were received from such a comparatively out-of-the-way corner of the world as Passarœan, Java.

Other still smaller and still less studied insects are undoubtedly carried by this method of transportation, as the recently discovered identity of certain North American Thysanoptera with those of Sweden and Russia would seem to show. The small plant-feeding mites of the family Phytoptidæ are particularly subject to this form of commercial distribution, and when they are fully studied, it will doubtless be found that many forms have become subcosmopolitan.

Of larger insects, nearly all of the wood-boring beetles common to Europe and the United States have probably been brought over in this way. *Zeuzera pyrina*, the large wood-boring cossid moth, also probably came over on living plants; and, as I have just stated, the newly imported brown-tail moth, *Euproctis chrysorrhœa*, was probably at Boston with nursery stock.

Careful observations on the insects transported with this class of merchandise have never been made, except, possibly, at the port of San Francisco. At this port the

State Board of Horticulture has established, under State laws, a quarantine for all incoming plants and fruit. The entomologist and quarantine officer, Mr. Alexander Craw, has entire jurisdiction over such articles consigned to points within the State, and examines, destroys and fumigates at his discretion. He has not, however, in his reports, given us complete lists of the insects collected in this work, although I understand, from persons who have visited his office, that he has preserved collections of the more important species from an economic standpoint. The vessels examined have, almost without exception, come from Pacific ports, and the difficulty of naming insect material thus received would be very great. It is this fact which has probably hitherto prevented the publication of a general list. A list of the scale insects, however, has been published.*

Between July 2, 1894, and August 29, 1896, Mr. Crew inspected 232 vessels carrying plants or other articles liable to be infested with living insects, and consigned to California individuals or firms. 122 lots he found clean and passed; 40 lots he admitted after fumigation; 20 lots he destroyed and 78 lots he destroyed in part. One lot, consisting of 1,000 boxes of apples, he sent back on the refusal of the owner to allow them to be fumigated.

Living plants and nursery stock afford, then, perhaps, the most certain means for the accidental transmission and subsequent establishment of many kinds of insects. Commerce in objects of this class is rapidly increasing and has already assumed considerable proportions, the imports into the United States alone in the fiscal year ending June 30, 1896, having reached a value of nearly $1,000,000, while the previous year they amounted to something over $600,000.

* Bull. 4. Tech. Ser. Div. Entom. U. S. Dept. Agric., 1896, pp. 40–41.

No great elaboration will be needed concerning the importation of foreign insects upon fruits, fresh and dry; other dry food stuffs; cloths; lumber, or domestic animals. Fruits were imported into the United States in the fiscal year 1895–6 to the value of nearly $20,000,000, and, unquestionably, upon imported fruits are carried many insects. The opportunities for the establishment of species coming with fresh fruit, however, are obviously slight as compared with those which come on living plants or in dried food-stuffs, and, as a matter of fact, it appears that already nearly all of the dried-food insects have become cosmopolitan. The same may be said of the insects which affect domestic animals. The forms which are truly parasitic in the larval stage have most of them been carried everywhere, while the other forms which attack domestic animals only as adults have some of them been carried far and wide. As an example, we may recall the European *Hæmatobia serrata*, which was brought to New Jersey probably in 1886, and which has spread over the entire country from Maine to California.

The fact that insects may be, and doubtless are, transmitted in the material used in packing heavy or delicate merchandise must not be overlooked. We have already shown that dangerous weeds have been transmitted in this way, and when the material is hay or straw the danger of importing certain injurious insects becomes great. *Cecidomyia destructor*, the well-known Hessian fly, is supposed to have first been brought to the United States from Europe in straw bedding on troop vessels during the War of the Revolution, and to have recently been carried from Europe to New Zealand in the straw packing of merchandise. Laws recently proposed in New Zealand, Australia and Cape Colony provide that such straw or hay packing shall be burned immediately the case is opened.

Dr. H. Loew, in his well known paper, 'Ueber die Diptern-fauna des Bernsteins,' has shown that several of the species of the genera *Oscinis* and *Chlorops* have gained a wide distribution through commerce, and this probably happened through their occurrence in hay or straw used as packing, since they live in the stems of grains and grasses. Dr. Loew, by the way, considered the Diptera, by virtue of the simple conditions required for their existence, to be peculiarly susceptible to commercial and accidental distribution, and was inclined to believe that the majority of the many species common to Europe and North America have been imported into the latter country. He understood, however, the existence of a circumpolar fauna and wrote wisely and learnedly about the common ancestry of what he called analogous species. Whatever may be the cause, the Diptera seem fitted in the individual to withstand widely differing environmental conditions. The group, as a whole, has apparently little faunistic value either along broad lines or in a more restricted way. There are comparatively fewer characteristic genera in the main faunal regions of the world than in other groups of animals, and in our own country there are comparatively few species of restricted distribution. Very many individual species range through the Lower and Upper Austral, through the Transition and into the Boreal regions.

Aside from the Diptera, grains and grasses all over the world are subject to the attacks of a host of insects of all kinds, many of which hibernate on or within the stems, so that the proposed legal provisions of the English colonies mentioned are by no means unwise. The substitution of the wood material known as 'excelsior,' the use of which is becoming so common in this country, or of some other packing material, will shortly do away with a large share of this danger.

There are, of course, other less important methods by which insects may be transported, such as in earth or damp moss about the roots of plants and in sand used for ballast. These methods, however, are not very important as a rule, although it is stated that the destructive chigoe (*Sarcopsylla penetrans*) was carried in ballast in 1872, on a vessel from Rio Janeiro to the coast of Guinea, where it has established itself most perfectly, having been found 200 miles inland by Stanley.*

There remains one more source of accidental introductions and it is one which has been reasonably prolific as regards insects on several occasions. I refer to international expositions, which are now becoming of almost annual occurrence. At the Centennial Exposition at Philadelphia, in 1876, the insects occurring in the exhibits, especially of foreign grains, received some study by Dr. Riley, who published a short note in the Proceedings of the St. Louis Academy of Science for October 2, 1876. A special committee of the Philadelphia Academy, consisting of Drs. Horn, Leidy and Le Conte also prepared and published a report at this time, but none but well known and cosmopolitan forms were found. I am not familiar with the results of any studies of a similar nature made at the Paris Exposition Universelle of 1889, but have seen the title of a paper by M. Decaux which reads 'Etudes sur les insectes nuisibles receuillis à l'Exposition Universelle,' Paris, 1890, which, however, I have not been able to consult.

In 1893, however, careful observations were made at the World's Fair at Chicago by Mr. F. H. Chittenden, the results of which were published by Dr. Riley in Volume VI. of Insect Life. Insects to the number of 101 species were found in grain and other stored vegetable products. Seven species were found affecting animal products

* 'Die Umschau,' July 17, 1897, p. 523.

and 13 wood-feeding species were found in the forestry building. The interesting and significant fact is mentioned in this article that there was an exchange of seed samples between the representatives of different countries, which would, of course, greatly facilitate the spread of seed-inhabiting insects, and it was further shown that thousands of samples were taken away from open bags by visitors from all parts of this country and probably from other parts of the world. Moreover, at the close of the Exposition the sheaves of cereals used in the decorations were taken away by armfuls by visitors. After summarizing the habits and countries of origin of the different species, however, Dr. Riley expressed the opinion that no dangerous importations were made at this time. It seems altogether likely, however, that *Phyllotreta armoraciæ*, a European species which has established itself in northern Illinois, Iowa and Wisconsin since 1893, and which was found by Mr. Chittenden in that year in vacant lots near the exposition grounds, was an exposition importation. Moreover, an interesting Calandrid of the genus *Tranes*, the species of which are all Australian, has established itself injuriously in greenhouses in St. Louis as the result of the introduction of two plants of *Zamia spiralis* which were bought at the World's Fair. With these instances in mind we cannot but admit that other species heretofore overlooked probably escaped and have become acclimatized as the result of this exposition, and that such occasions, occurring as they do more and more frequently and drawing constantly increasing material from all parts of the world, will, unless precautionary measures are instituted, afford more and more frequent opportunities of a very favorable kind for the spread of injurious species.*

We have thus seen how great the opportunities are under our modern conditions for the transportation, in proper condition for establishment, of insects of many groups, and from this point of view it seems strange, in view of the very numerous importations, that more species do not become acclimatized even in North America, where, perhaps, we reach the greatest possibilities in this direction. Our most intimate commercial relations are with the great faunal region most like our own, and these relations are rapidly growing both with Europe on the east and with Asia on the west, although our Asiatic importations are more abundant from the Oriental region than the Palearctic, and from the Oriental we are not so likely to receive species which will acclimatize themselves. We have already pointed out that the faunistic relations with the Coleoptera (and undoubtedly with other groups) are least marked between the north temperature and south temperate regions, and this distinction is never likely to be disturbed by imported species on account of the diametrically opposed seasons. A species starting from Argentina in the height of summer will reach the United States in the dead of winter at a time least likely to favor its acclimatization. This point was first suggested by my colleague, Mr. E. A. Schwarz, in his paper entitled 'The Coleoptera common to North America and other Countries' (Proc. Entom. Soc. Wash. I., 182–194).

It appears from what we have shown that very many species are constantly being imported which do not become acclimatized. Many of the European species which we should most expect to take hold in this country have not done so, while

* During the later months of the World's Fair precautionary measures were instituted under Mr. Chittenden's supervision. Much dry food material was fumigated with bisulphide of carbon, and many samples which were very badly infected were burned. At least four new and dangerous species of insects were destroyed in this way.

with others it is the unexpected which has happened. As Osten Sacken says, speaking of the Diptera: "Importation will not occur for centuries in cases where it might be expected from day to day; and, again, it will sometimes take place under circumstances most improbable, and, *a priori* impossible to foresee." (Proc. Entom. Soc. Lond., 1894, p. 489.)

Why should the well-known *Pieris rapæ* have made its appearance in this country and spread far and wide, while the equally common and injurious *Pieris brassicæ* and *P. napi* have never been found here? Why should *Phytonomus punctatus* have flourished with us when it is hardly known as a clover enemy in Europe, and when the congeneric *Phytonomus meles* of Europe has never been found here? Why should *Coleophora laricella* have established itself here, and none of the other European Coleophoras (some of them of much greater distribution and hibernating in cases of protective coloration and shape, and attached to plants) have acclimated themselves amongst us? Why should *Calliphora vomitoria*, *Crytoneura stabulans* and *Stomoxys calcitrans* have been brought over at an early date and flourished to excess in America and many other countries, while *Sarcophaga carnaria* is unknown in any of them?

Mr. Schwarz has phrased it: "We stand here before some great unknown factor, viz, the individual character and inmost nature of the species which governs the introduction or non-introduction of each species—a factor which is variable according to each species * * *." But there is is no reason why a mystery need be made of this condition. In a word, it is the capacity of the individual species to accommodate itself to a more or less novel environment. Nowhere in the whole animal kingdom do we find the natural environment more complicated than with insects. Conditions are frequently dependent upon conditions in an almost endless chain. The phenomena of fatal parasitism are of vital importance as determining the abundance of the species and are curiously complicated. I have recently proved the existence of several fatal tertiary parasites and the probable existence of quaternary parasites with *Orgyia leucostigma* in Washington. Upon the condition of this chain of interdependencies rests the welfare of the primary host. If adverse conditions affect the quaternary parasite, the primary host suffers, for the tertiary parasites increase and kill off the secondary parasites, allowing an increase of the primary parasites which kill off the Orgyia. The famous instance of Darwin in which he showed that in a measure cats are responsible for the production of clover seed in England through the interrelations of cats, field mice and bumble-bees, is paralleled and outdone again and again among insects. Further, in no group of animals are the characteristics termed special protective resemblance and special aggressive resemblance, to say nothing of protective and aggressive mimicry, so well marked and so important in the life of the species as with the insects. *It is upon the degree of simplicity of its life—the degree of simplicity of its normal environment as a whole—that the capacity of a species for transportation and acclimatization, even into a parallel life zone, depends.*

Nevertheless, I am fully convinced that very many more species will stand transportation from the Palearctic to the Nearctic, from the Australian to the Oriental and the Neotropical regions, than would be supposed from a consideration of these points and from a knowledge of the comparatively few forms which have as yet been transported and acclimatized. Aside from the forms brought in with their food and thus under the most favorable conditions for establishment, it is only by a lucky chance with the average accidental

insect immigrant that it finds conditions for reproduction—a chance which may not occur once in very many times. Osten Sacken has pointed out that *Eristalis tenax* must have been brought here many times during four hundred years before it succeeded in establishing itself. Undoubtedly many of these immigrants die upon our wharves when a lucky chance like crawling upon the clothes of a person and thus being carried out into the country might have resulted in the establishment of the species. Given the *most favorable conditions* and many species will be able not only to accommodate themselves to a new environment, but certain of them will thrive better in the new than in the old. The effort to transport beneficial species from the Australian region and acclimatize them in the Nearctic region seemed a rash and unprofitable experiment on its face, and I confess that I for one had little hope of its success, yet it was successful with several species and transcendently successful with one.

Much has been written of late about the success of the work in the introduction of beneficial insects by Mr. Albert Koebele into Hawaii, under the auspices of the Hawaiian government. Some of the introductions seem, without doubt, to have been strikingly successful. Mr. R. E. C. Perkins has reported at some length upon this success and, in commenting upon its reasons, says:

"It becomes natural to ask why the success of the imported beneficial insects has been so pronounced here, while in other countries it has been attained in a comparatively small measure. The reason, I think, is sufficiently obvious. The same causes which have led to the rapid spread and excessive multiplication of injurious introductions have operated equally on the beneficial ones that prey upon them. The remote position of the islands, and the consequently limited fauna, giving free scope for increase to new arrivals, the general absence of creatures injurious to the introduced beneficial species, and the equability of the climate, allowing of almost continual breeding, may well afford results which could hardly be attained elsewhere on the globe. The keen struggle for existence of continental lands is comparatively non-existent, and, so far as it exists, is rather brought about by the introduced fauna than by the native one."

Mr. Perkins' reasons are all good, but he has not mentioned one prime reason of success, and that is that the most successful of the imported species have come from another portion of the same great faunal region, while others have been received from the region most closely allied, viz, the Oriental.

Wallace took the view that the effectual migration of insects is, perhaps, more than with any other class of animals, limited by organic and physical conditions. "The vegetation," he says, "the soil, the temperature, and the supply of moisture, must all be suited to their habits and economy; while they require an immunity from enemies of various kinds, which immigrants to a new country seldom obtain."

There is much truth in this statement, but it must be remarked that, in practical experience, immunity from enemies of various kinds is what insect immigrants find, not what they leave behind them. It takes some time before they weave a new chain of organism preying upon organism. Our insect importations from abroad when they are of economic importance, and those from Europe are very likely to be of such importance, leave their old insect enemies behind them and frequently are not readily attacked by native ones. These last accommodate themselves to the new comer in time, but for a while he enjoys comparative immunity. The rapid multiplication and spread of *Pieris rapæ*, of *Hæmatobia serrata*

of *Phytonomus punctatus*, of *Porthetria dispar*, of *Anthonomus grandis*, of *Icerya purchasi* and many others may probably be principally laid to this cause.

I should be remiss did I not refer to another aspect of the accidental introduction of species, viz, that it not only adds species to a native fauna, but also that it often causes the disappearance of native forms. Since the establishment, within our boundaries, of *Pieris rapæ*, our native *Pontia oleracea* has almost entirely disappeared in localities in which it formerly abounded, and in some sections has entirely disappeared. Since *Doryphora 10-lineata* came east and multiplied upon the cultivated potato in such prodigious numbers, the formerly common eastern *Doryphora juncta* has become a rare species. Walsh pointed out 30 years ago that one effect of the westward spread of the European *Mytilaspis pomorum* was to cause the gradual local disappearance of the native *Chionaspis furfurus*. Hubbard has shown that the increase of the imported *Mytilaspis citricola* in Florida was followed by the decrease of *Mytilaspis gloverii*, which, though not native, was an earlier importation—a most interesting, and, so far as records go, unique case. Instances might be multiplied which will show that the establishment of foreign species thus often produces at least a dual effect on the character of the fauna as a whole.

In closing, it will not be inappropriate to point out that the accidental importation of species is only one of the ways in which the agency of man is altering the character of native faunas, and that, in spite of its extent, it is really the least of the ways. The influence of civilization is immediately destructive to natural floras and faunas. It is already too late to gain an adequate idea of natural conditions in even recently settled portions of the globe. Wallace has dwelt upon the comparatively scanty and unimportant results to natural history of most of the great scientific voyages of the various civilized governments during the present century, from which it has resulted "that the productions of some of the most frequently visited and most interesting islands on the globe are still very imperfectly known, while their native plants and animals are being yearly exterminated. * * * Such are the Sandwich Islands, Tahiti, the Marquesas, the Phillippine Islands and a host of smaller ones; while Bourbon and Mauritius, St. Helena and several others have only been adequately explored after an important portion of their productions has been destroyed by cultivation or the reckless introduction of goats and pigs." ('Island Life,' p. 7.)

Elsewhere he shows that the introduction of goats into St. Helena utterly destroyed a whole flora of forest trees, and with them all the insects, mollusca, and perhaps birds dependent upon them. And further, that "cattle will, in many districts, wholly prevent the growth of trees; and with the trees the numerous insects dependent on those trees, and the birds which feed upon the insects, must disappear as well as the small mammalia which feed on the fruits, seeds, leaves or roots." Many local American instances have been brought together by Mr. F. M. Webster in an important paper entitled 'Biological effects of civilization on the insect fauna of Ohio,' which comes to me as I write these closing lines.

But the purpose of this address has been to dwell solely upon the question of the spread of species, and I must not touch upon other topics, however closely akin. It seems to me that the practical point to which we must come, after summarizing all that has been shown, is that since so many species have been imported by pure accident, and have succeeded perfectly in becoming acclimatized, may not much be accomplished by wisely planned and carefully guarded

introductions? The somewhat haphazard but none the less important and skillful work of Albert Koebele, first for the United States government, afterwards for the State of California, and now for the Hawaiian government, is certainly an indication, taken in connection with what we have shown, that thorough experimental work with predaceous and parasitic insects promises, in especial cases, results of possibly very great value.

We wish no more destructive birds like the English Sparrow; we have no desire to make an American resident of the Indian Mongoos, nor have we any desire to import the Australian flying fox as a pet. Neither do we desire to allow any more European plants to escape from cultivation and emulate the Russian Thistle. But there are many absolutely beneficial insects of Palearctic regions which might flourish amongst us, and whose intentional introduction could not be harmful from any point of view, while they might be of the greatest service.

L. O. Howard.

Washington, D. C.

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*PHYLOGENY AND TAXONOMY OF THE ANGIOSPERMS.**

It is unnecessary for me to state at the outset, what is evident to every botanist, that it is as yet impossible to present a complete phylogeny of the angiosperms. Phytopaleontology is too young a science, and the materials with which it deals are as yet far too scanty to have given us direct evidence as to the phylogeny of all families of plants. No one can trace with great certainty from the fossil remains of plants yet discovered the genealogy of any considerable portion of the vegetable kingdom. It will be many a year before the direct evidence we so much desire will leave no considerable gaps to be filled by skillful interpolation. However, after making all due allowance for the imperfection of the record, there are many facts as to past vegetation which are well established. Thus we know that the earliest plants were simple, homogeneous-celled, aquatic organisms. We know that ferns and gymnosperms preceded angiosperms. We know that the angiosperms which first appeared were of lower types, and that the highest types known to-day were wanting until very late in geological time.

It is true, moreover, that we are not confined to the direct evidence furnished by the paleontological record. In the individual development of every plant (its ontogenesis) there is a recapitulation of its ancestral development (phylogenesis). A critical study of the development of the individual must throw light upon the past history of the species. When we know every step in the formation of each plant we shall be able to trace the phylogeny of every species. Here, again, we have to face the fact that our knowledge is still quite fragmentary and that on this account the results are not as definite as we could wish, and yet, when we bring together what we know of the ontogeny of plants here and there in the higher groups, we are able to make out with much certainty not a little as to their phylogeny. To the details regarding these results I will advert somewhat later.

There is still another line of inquiry open to us, namely, the morphological, in which account is taken of the varying development of homologous tissues, members and organs. Rightly interpreted, the results of morphological studies are of very high importance in determining genetic relationships. When differences in homologous parts are regarded as but the expression of variation from a common form they become indices of relationship, and when

*An abstract of the address of the retiring president, delivered before the Botanical Society of America, Toronto meeting, August 17, 1897.

these indices, obtained from all the tissues, members and organs of a group of plants, are judiciously considered they mark out lines of descent with great distinctness.

We have thus open to us three lines of investigation in the study of the phylogeny of plants, namely: (1) the historical, in which the materials are supplied by phytopaleontology; (2) the ontogenetic, in which the development of the individual supplies us with the necessary data; and (3) the morphological, in which the different development of homologous parts is our index of relationship. In this paper I propose to bring these three lines of investigation to bear upon the problem of the phylogeny of the angiosperms. * * * *

From all the foregoing we may pretty safely proceed to construct the hypothetical phylogeny of the angiosperms, to serve as the basis of their taxonomy. And let it be fully understood that this is not presented as final, or as entirely satisfactory; it is merely a working hypothesis which claims no other merit than that of an attempt at conformity to the suggestions, sometimes faint, sometimes doubtful, from paleontology, from embryology (ontogeny) and from morphology. That some of these suggestions have been misinterpreted or that others have been overlooked is altogther likely, but in this I beg the indulgence of systematists, who may well realize the difficulties surrounding the problem here undertaken.

HYPOTHETICAL PHYLOGENY OF ANGIOSPERMS.

The angiospermous phylum parted very early into two sub-classes, the Monocotyledons and Dicotyledons. This separation took place while the flower strobilus was still apocarpous, and before any of the strobilar leaves had undergone much if any modification. At this stage the vegetative characters of the sporophyte were so well established that no profound modifications have been undergone since.

The modifications which gave us the main lines of monocotyledons were, first, the fusion of the carpels with one another and the production of a syncarpium, and second, the progressive fusion of the syncarpium with the other strobilar leaves. These resulted in the phylum which begins with Apocarpæ and passes to Coronarieæ, Epigynæ and Microspermæ. In some Apocarpæ and many plants of the type of the Coronarieæ the perianth has been more or less reduced (by aphanisis), in some cases amounting to complete suppression, as in palms, aroids, and sedges and grasses.

The primitive dicotyledons were apocarpous plants which soon developed along two diverging lines, characterized in the one case by the tendency of the leaves of the strobilus to fuse with each other in a transverse direction (transverse symphysis), while in the other the tendency was to a fusion of the leaves in two directions (transverse and longitudinal symphysis). The phylum resulting from the predominance of transverse symphysis began with the apocarpous Ranales, soon developing into the syncarpous Caryophyllales and Malvales. The type of the Caryophyllales became slightly modified in the Primulales by the transverse symphysis of the inner perianth-whorl, resulting in gamopetaly.

In the Polemoniales the type of the Primulales began to undergo modification by aphanisis, resulting in a reduction of the microsporophylls to five, and the carpels in the syncarpium to two or three. Increasing aphanisis produced the Personales and Lamiales with their four or two microsporophylls and irregular perianth, and in the latter group with each carpel restricted to the production of but one or two macrosporangia.

The phylum in which both transverse and longitudinal fusion are well marked proceeds from the apocarpous roseworts to the syncarpous saxifrages of the Rosales,

to the Celastrales in which epigyny is sometimes attained, thence to the Umbellales, where epigyny is constant, and to the Rubiales in which gamopetaly has become a fixed character, culminating in the group of the Asterales with its greatly reduced bicarpellary syncarpium.

Early predominance of aphanisis in some members of the Ranale phylum soon gave rise to the apetalous laurels and nutmegs from the buttercup type. A somewhat later appearance of aphanisis gave rise to the willows, amaranths and buckwheat from the pink type, and the spurgeworts and nettleworts from the mallow type. Similarly, early predominance of aphanisis in the Rosale phylum gave rise to the apetalous plane-trees from the rosewort type, while its later appearance gave rise to the proteads, daphnads, oleasters, sandalworts and loranths from the holly type, and the walnuts, oaks and galeworts from the horsechestnut type.

Early predominance of symphysis gave rise to the peculiar group of the myrtles from the rosewort type, in which by later aphanisis came the hippurids, birthworts and vine-rapes. The Parietales and Polygalales are later developments more or less parallel to the Caryophyllales, while the Geraniales and Guttiferales stand in a similar relation to the Malvales.

TAXONOMY OF ANGIOSPERMS.

As a result of the investigation of phylogeny along the lines of paleontology, embryology and morphology, the following suggestions as to the classification of angiosperms are made:

The angiosperms are separable into two diverging sub-classes, the monocotyledons (Monocotyledoneæ) and the dicotyledons (Dicotyledoneæ), the first ranking structurally lower than the second. The monocotyledons are well divided by Bentham and Hooker into seven series, and these we may accept unchanged with the single exception that the waterworts (Hydrocharitaceæ) should probably be removed from the Microspermæ, to constitute an additional coordinate group. These eight groups, which appear to be deserving of no more than ordinal rank, should then be re-arranged so as to have the following sequence, namely: Apocarpæ, Coronarieæ, Nudifloræ, Calycinæ, Glumaceæ, Hydrales, Epigynæ, Microspermæ. Here it must be understood that the Nudifloræ, Calycinæ and Glumaceæ are separate orders radiating from the present order Coronarieæ, and that the Hydrales constitute a diverging order from the base of the Epigynæ.

The choripetalous and gamopetalous dicotyledons are divided by Bentham and Hooker into six 'series,' one of which, the Discifloræ, should be broken up and its families distributed elsewhere. The remaining 'series,' which appear to have the rank of orders, form two somewhat diverging genetic lines or phyla, each beginning with apocarpous, hypogynous, choripetalous plants, and both attaining syncarpy and gamopetaly, one remaining hypogynous, the other becoming epigynous. An attempt has been made to distribute all the apetalous plants, these having been assigned places in the lower two orders. Since gamopetaly has evidently been attained at more than one point, it is no longer desirable to retain the Gamopetalæ as a distinct group. It must constantly be borne in mind that these orders and their sub-orders, as well as the families, are diversely related to one another, sometimes serially, but more commonly divergently, as the twigs of a tree are related, now by direct extension, and then by lateral branching.

Class ANGIOSPERMÆ.

Sub-class MONOCOTYLEDONEÆ.
- Order Apocarpæ (3 families).
- Order Coronarieæ (8 families).
- Order Nudifloræ (5 families).

Order Calycinæ (3 families).
Order Glumaceæ (5 families).
Order Hydrales (1 family).
Order Epigynæ (7 families).
Order Microspermæ (2 families).
Sub-class DICOTYLEDONEÆ.
Order Thalamifloræ.
Sub-order Ranales (12 families).
Sub-order Parietales (12 families).
Sub-order Polygalales (4 families).
Sub-order Caryophyllales (13 families).
Sub-order Geraniales (11 families).
Sub-order Guttiferales (6 families).
Sub-order Malvales (11 families).
Order Heteromeræ.
Sub-order Primulales (4 families).
Sub-order Ericales (7 families).
Sub-order Ebenales (4 families).
Order Bicarpellatæ.
Sub-order Polemoniales (5 families).
Sub-order Gentianales (6 families).
Sub-order Personales (8 families).
Sub-order Lamiales (4 families).
Order Calycifloræ.
Sub-order Rosales (12 families).
Sub-order Myrtales (9 families).
Sub-order Passiflorales (6 families).
Sub-order Celastrales (13 families).
Sub-order Sapindales (8 families).
Sub-order Umbellales (3 families).
Order Inferæ.
Sub-order Rubiales (2 families).
Sub-order Campanales (3 families).
Sub-order Asterales (4 families).

CHARLES E. BESSEY.
THE UNIVERSITY OF NEBRASKA.

BOTANICAL SOCIETY OF AMERICA.

THE most successful meeting which this young but flourishing society has yet held has just closed at Toronto. Although only three years old, both the attendance at the meeting and the great variety and strength of the papers read would be worthy of a much older organization. Every facility was afforded to the Society, through the courtesy of the Local Committee of Arrangements for the meeting of the British Association. The sessions, presided over by Dr. John M. Coulter, were held in the lecture hall of the handsome Biological Building in which this department of the University of Toronto is quartered. Besides the members, there were present a considerable number of British, Canadian and United States botanists. Foreign botanists had been invited by the Council to sit as associate members of the Society for this meeting. Among those present were Professor H. Marshall Ward, Professor F. O. Bower, Mr. Harold Wager, Mr. J. Bretland Farmer and Mr. J. Reynolds Green.

The officers of the Society are elected by ballots distributed by the Secretary by mail, and returned to him by the members. The Council canvassed the vote for officers and announced at the first meeting of the Society that the following had been elected for the year 1898: President, N. L. Britton, of New York; Vice-President, J. C. Arthur, of Lafayette, Ind.; Secretary, C. R. Barnes, of Madison, Wis.; Treasurer, Arthur Hollick, of New York; Councillors, B. L. Robinson, of Cambridge, Mass., and F. V. Coville, of Washington.

A very cordial invitation was sent by the Director and Trustees of the Missouri Botanical Garden urging the Society to hold a meeting in the spring of 1898 at the Garden, as their guests. The Society was obliged reluctantly to decline this invitation, inasmuch as it desires to cooperate with the A. A. A. S. at its semi-centennial next August in Boston, and it was not felt expedient to hold two meetings so close together.

The proposal to amend the constitution so as to reduce the dues met with no favor. It was unanimously laid upon the table, as was also the proposition to establish one or more medals to be awarded for valuable research. The discussion over the last proposition brought out the fact that the Society prefers to expend such funds as it receives for the promotion of research rather than for its reward.

Nine new members were elected. To

secure membership a candidate is first proposed by three members of the Society, who vouch for his eligibility under the constitution, which requires that he be actively engaged in research and the author of at least three contributions to knowledge in botanical lines. After notice of his candidacy has been sent to all members of the Society, written objections to him may be filed with the Secretary by any member. The Council then considers the candidates proposed and recommends such as it thinks proper. These names are then presented to the Society. One-fifth of the votes cast, if negative, will defeat any candidate.

The address of the retiring President, Dr. Charles E. Bessey, of the University of Nebraska, was delivered on Tuesday evening. A full abstract of the address is printed elsewhere in this number.

The following papers were read at the opening sessions on Wednesday:

B. L. Robinson: A case of ecblastesis and axial prolification in *Lipidium apetalum*.

J. C. Arthur: Movement of protoplasm in cœnocytic hyphæ.

John M. Coulter: Pollen grains and antipodal cells.

Frederic E. Clements (presented by C. E. Bessey): The transition region of the Caryophyllales.

D. P. Penhallow: A revision of the species *Picea* occurring in northeastern America.

Edward L. Greene: Bibliographic Difficulties.

William Fawcett: The botanical gardens of Jamaica. Read by title.

Mr. Fawcett, finding himself unable to be present, sent his paper by post, but it unfortunately was not received in time to be presented. The Council had invited Drs. D. T. MacDougal and D. H. Campbell to present, in connection with this paper, their report upon the island of Jamaica as a site for the proposed tropical laboratory. It was intended that Dr. Fawcett's account of the botanic gardens should present, by means of lantern illustrations, an idea of the facilities already provided there. Although obliged to forego this, Dr. MacDougal spoke of the physical features and climate of the island, and Dr. Campbell discussed its botanical resources. The great interest with which the report was listened to indicates the desire which every botanist feels to have this proposed laboratory in early operation.

The Council also invited Mr. Herbert J. Webber to present before the Society an account of his remarkable discoveries in connection with the fertilization of Zamia. Mr. Webber spoke of the development of the pollen tube and of its spermatozoids and of the way in which they effect the fertilization of the egg. After the meeting Mr. Webber displayed the preparations in which he had made his discoveries. These were examined with the greatest interest.

It will be seen by an inspection of the foregoing list that the papers presented touched all of the great fields of botanical science, with the exception of phyto-geography. Sessions of two hours in the morning and three and a-half in the afternoon were barely sufficient for the completion of the program. At the next meeting, which is to be held in Boston in connection with that of the A. A. A. S., the reading of papers will probably have to be begun a day earlier.

C. R. Barnes,
Secretary.

THE INTERNATIONAL MATHEMATICAL CONGRESS.

The meeting at Zurich, August 9th–11th, of the International Congress of Mathematicians was in every way a success. More than two hundred members took part. America sent seven representatives, including, however, three Cambridge graduates, now transplanted to Pennsylvania, Profes-

sors Harkness, Morley and Charlotte Scott. The greatest mathematician in the world, Sophus Lie, was not expected; and the greatest French mathematician, Poincaré, though down for a speech, did not come; but the actual program was particularly rich and interesting.

It is very noteworthy that the Congress was divided into five sections: (1) Arithmetic and Algebra; (2) Analysis, and Theory of Functions; (3) Geometry; (4) Mechanics and Mathematical Physics; (5) History and Bibliography.

The program of the first section contained the only title in English: 'On Pasigraphy, its present state and the pasigraphic movement in Italy,' by Ernst Schroeder, of Karlsruhe, author of 'Algebra der Logik.'

The second section contained a title from Z. de Galdeano, whose heroic efforts gave Spain a Journal of Mathematics, now unfortunately dead in the decadence of that beautiful, priest-ridden land.

The program of the third section, the only one consecrated wholly to a single title, Geometry, contained two titles on the non-Euclidean geometry.

Burali: Les postulats pour la geométrie d'Euclide et de Lobatschewsky.

Andrade: 'La statique non euclidienne et diverses formes mécaniques du postulatum d'Euclide.

In Section IV. Stodola treated an important subject, 'Die Beziehungen der Technik zur Mathematik.'

In the fifth section Enestrõm gave an important discussion of bibliography, a point where the Congress can and will render aid of fundamental importance.

In the first general assembly Rudio spoke on the aim and organization of international mathematical congresses.

It was determined that the next Congress should take place at Paris in 1900, under the auspices of the Société mathématique de France.

As aims were specified: (1) to promote personal relations between mathematicians of different lands; (2) to give, in reports or conferences, an aperçu of the actual state of the divers branches of mathematics, and to treat questions of recognized importance; (3) to deliberate on the problems and organization of future congresses; (4) to treat questions of bibliography, of terminology, etc., on subjects where an *entente international* appears necessary.

Rudio mentioned the yearly issue of an address-book of all mathematicians of the world with indication of their specialties; also of a biographic dictionary of living mathematicians with portraits; also of a literary journal for mathematics.

At the second general assembly Peano gave a conference: 'Logica matematica;' and Felix Klein a conference on teaching higher mathematics.

Three important resolutions were introduced by Vasiliev, of Kazan; Laisant, of Paris, and G. Cantor, of Halle, constituting: (1) a commission for preparation of general reports; (2) a standing bibliographic and terminology commission; (3) a commission to give the congress a permanent character by archives, libraries, stations for correspondence, editing or publishing noteworthy works, etc.

Surely this Congress has proven that it came only in the fullness of time, and that the world moves!

GEORGE BRUCE HALSTED.
AUSTIN, TEXAS.

CURRENT NOTES ON ANTHROPOLOGY.

NEW MUSEUM PUBLICATION.

IN May appeared 'Bulletin Number 1,' of the Free Museum of Science and Art, Philadelphia, a neat octavo of fifty pages, with illustrations. The announcement states that it will be published four times a year, at the subscription price of one dollar

a year. It will contain 'a résumé of the collections made by the Museum, notices of publications referring to museum work, and brief papers by the officers of the Museum.'

The present number contains two such papers, both by myself, one on 'The Pillars of Ben,' which are some curious monoliths in Chiapas, and the other on the Greek *Murmex* (referred to in SCIENCE, April 16, 1897). The notes on the accessions to the Museum are edited by Mr. Stewart Culin, the Director, and are arranged geographically. They present descriptions with cuts of a curious carved pebble from the Delaware valley, a horn arrow-straightener from the Pueblo Indians, name tablets from Corea, an inscribed stone from the thirteenth Egyptian dynasty described by the curator, Mrs. Sara Y. Stevenson, and a number of other interesting specimens.

Such a publication will be not only creditable to the Institution, but will prove a valuable reference work for students in archæology and ethnography.

BOTANY OF THE KLAMATHS.

A RECENT publication of the United States Department of Agriculture is a paper on the plants used by the Klamath Indians of Oregon, by Mr. Frederick V. Coville. It well illustrates how closely the aborigines studied their plant environment and drew their supplies from the vegetable world to the full extent that it was capable of furnishing. Mr. Coville gives the native names for more than a hundred species, all of which were utilized for food, clothing, dyeing, tool-making, 'medicine,' smoking, etc. He succeeded in identifying all the plants in use, and also obtained the native designations from educated Klamaths. He gives these with the diacritic marks used in the Century Dictionary; though it would have been better to have had recourse to the orthography adopted in the Klamath-English Dictionary, published by the United States Geographical Survey in 1890.

D. G. BRINTON.
UNIVERSITY OF PENNSYLVANIA.

NOTES ON INORGANIC CHEMISTRY.

THE *Revue Universelle des Mines* contains in the last number an article by Franz and Büttgenbach on the saline deposits of northern Germany in which a very full description is given of the Stassfurt salt beds. Twenty-five different mineral species are found in these deposits, of which the most important are the sylvine and kainite, so extensively used as fertilizers. The mean thickness of the potassium salt beds is at least twenty meters, and the quantity is estimated at ten billion tons. About three million tons are mined annually, so that at the present rate the supply would last thirty-three centuries.

THE British Home Office has issued an amendment to their order of February last, regarding the keeping of calcium carbid. The new order permits the keeping of quantities less than five pounds provided it is hermetically sealed in closed metal vessels containing not more than one pound each. Unless so kept no quantity whatever may be held without a license. Such restrictions, which are not peculiar to Great Britain, illustrate one method of powerful corporations to stifle competition. It appears that these orders result not so much from the intrinsic danger in calcium carbid as from a fear, on the part of those interested in gas, oil and electric lighting, of rivalry in the use of acetylene.

G. P. DROSSBACH discusses in the *Journal für Gasbeleuchtung* the fact that, while pure thorium oxid has a feeble glow in the Bunsen flame, when a per cent. or less of cerium oxid is present the light is increased ten or twelve fold. He attributes the ac-

tion of the cerium oxid to 'resonance;' the vibrations of the thoria molecules are not synchronous with those of the Bunsen flame, but the presence of a small amount of ceria brings them in accord, as a bit of wax will bring into accord two tuning forks of slightly different pitch. This, Drossbach thinks, is the reason that the mantles for the Welsbach burner must contain ceria as well as thoria.

IN the *Ztsch. angewante Chemie*, Lunge and Millberg add a fresh chapter to the controversy regarding the solubility of quartz powder in alkalies. They find that the solubility depends very largely on the fineness of the powder; if fine enough the quartz dissolves completely in both caustic soda and caustic potash on boiling, and the carbonates exercise a decided solvent action. Since clays and similar derived material contain crystallized silica in a state of extremely minute subdivision, there is hence no method now known of accurately determining the proportions of crystallized and amorphous silica present.

IN January last at Hannover, after a period of cold weather, there fell on the rising temperature a snow in the form of compact balls. Many of these balls were simple and completely transparent, and consisted of single, simple, spherical crystals. These are described by F. Rinne in the *Jahrbuch für Mineralogie*. Apparently they were crystallized rain drops, but all efforts to make them artificially were without result. They resembled the chondrites of many meteorites, and these also Dr. Rinne finds it impossible to form artificially.

W. STELZER in the *Pharm. Centr.-Halle* records the examination of several solvents for ozone. Olive oil dissolves 100 volume per cent. of ozone, and this preparation is manufactured by Spranger, of Berlin, under the trade name of 'electron.' Codliver oil takes up 200 volume per cent. ozone, and loses thereby its disagreeable taste and odor. Spranger's 'tincture of ozone' is a solution of ozone in terpene and is probably a chemical compound. One sample examined had lost little of its ozone in fifteen months. Fats and oils which contain no oleic acid and which do not absorb iodin, such as vaseline and other petroleum oils, do not dissolve ozone.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

THE prize established by the city of Moscow to be awarded at each International Medical Congress for the medical work of greatest benefit to mankind has been bestowed by the present Congress on M. Henri Dunant, the founder of the Red Cross Society.

PROFESSOR VON KÖLLIKER, of Würzburg, who recently celebrated his eightieth birthday and the fiftieth anniversary of his appointment as professor, has been awarded the gold Comenius medal of the Imperial Leopold-Carolina Academy of Halle.

IT is proposed to erect a tablet in honor of Professor Giuseppi Sanarelli, the discoverer of the microbe of yellow fever, at the University of Sienna, of which he is an alumnus.

THE death is announced, at the age of sixty-nine years, of Dr. Jules Bernard Luys, known for his researches on the brain and nervous system, and less favorably for his publications on hypnotism and telepathy.

WE regret also to record the death of Mr. Isaac N. Travis, taxidermist and naturalist in the American Museum of Natural History, New York.

MR. W. W. WOOLEN proposes to present to the city of Indianapolis fifty-six acres of land for a botanical garden and an ornithological preserve.

THE late Marshall Harris bequeathed $60,000 for a public library in Oshkosh, Wis., on condition that an equal amount be collected, and ex-Senator Sawyer, of Wisconsin, has subscribed $25,000 towards the amount.

EMPEROR FRANCIS JOSEPH, of Austria, has given his consent to the union of the two great

imperial libraries at Vienna, the Hofbibliothek and the Private Imperial Library. The latter has not hitherto been opened to the public. It possesses a famous collection of portraits, said to exceed 200,000 in number.

As many of the fish brought to the New York Aquarium have died from the effects of injuries received in transit, it has been decided to establish a fish hatchery as one of the departments of the aquarium.

Mr. James Perry has brought suit against the American Museum of Natural History to recover a balance of $400,612.75 with interest, which he alleges to be due him for an archæological and ethnological collection purchased by the Museum.

Dr. Charrin has been appointed director of a laboratory of experimental medicine which has just been established in the Collège de France.

A Bacteriological Institute has been established at Mons, Belgium, by the Provincial Council, which gives it a subsidy of 6,500 fr. 10,000 fr. have been given to the Institute by an anonymous donor.

The ninth International Congress of Hygiene and Demography will be held at Madrid from the 10th to the 17th of April of next year.

The Australasian Chamber of Mines in London are making arrangements for an International Mining Machinery and Metallurgical Exhibition to be held in London in 1899, in time for the exhibits to be forwarded to the Paris Exposition in 1900.

The partial cessation of the plague at Bombay has been followed by an epidemic of cholera, which seems not to have attracted much attention. During the last week for which advices have been received there were 220 deaths from cholera. There were still during that week 18 deaths from the plague.

The British Medical Association held its sixty-fifth annual meeting at Montreal last week, following the program which has been already published in this Journal. At the first session, on the afternoon of Tuesday, August 31st, addresses of welcome were made by Mr. Wilson Smith, mayor of the city; by Mr. Adolphus Chapleau, Lieutenant-General of the Province of Quebec, and by the Earl of Aberdeen, Governor-General of Canada, and Dr. T. G. Roddick delivered the President's address. Dr. Roddick, after welcoming the members and guests, referred to the history of the Association from its foundation at the initiative of Sir Charles Hastings in 1832, and then considered especially the Canadian climatic conditions and health resorts, and concluded with a review of medical education and medical legislation in Canada. On the following afternoons, Wednesday, Thursday and Friday, the general addresses were given. The address in medicine was given by Professor William Osler, of Johns Hopkins University, who, it appears, is still a Canadian citizen. His address was entitled 'British Medicine in Greater Britain,' and took a wide survey, including a comparison of the Greek and British races and the influence of the former on the latter. The address in surgery was by Dr. W. Mitchell Banks, Liverpool, who confined his address to the work accomplished by military surgeons. The address on public medicine, given on Friday afternoon, was by Dr. H. M. Biggs. A general address was given by Professor Charles Richet, who chose as his subject 'The work of Pasteur and the Modern Conception of Medicine.' During the mornings sessions of the Sections were held. The Proceedings, to be published in the *British Medical Journal*, will bear witness to many important addresses, papers and discussions. At a special session of convocation McGill University conferred the honorary degree of LL.D. on Lord Lister, Sir W. Turner and Drs. Broadbent, Gaskill, McAllister, Watson Cheyne, Henry Barnes and A. G. Wheelhouse.

The continuity of national associations for the advancement of science is exemplified by the fact that the German Association, which meets in Brunswick in September, has been invited to make an excursion to Pyrmont, where its seventeenth meeting was held in 1839.

Eight hundred geologists were in attendance at the recent International Geological Congress, of whom about two hundred and fifty were Russians. No reports of the meetings have been cabled to the daily papers, but we hope to pub-

lish shortly an article on the work of the Congress.

THE American Social Science Association held its general meeting in Saratoga last week. Mr. Frank B. Sanborn, who for more than twenty years has been Secretary of the Association, on resigning, presented a report tracing the history of the Association, which he thought was not accomplishing as much as it should. A number of interesting papers were, however, presented at the Saratoga meeting. Judge Simeon E. Baldwin, New Haven, was elected President and Mr. F. Stanley Root, New Haven, Secretary.

THE French government proposes to send an official expedition to Egypt, starting from Marseilles on October 28, 1897, and returning in the month of December. The expedition will be under the direction of Professor Révillont. Volunteers willing to pay their own expenses will be allowed to join. The arrangements are in the charge of M. Maurice Junot, of Rue de Rome, Paris.

WE learn from *Natural Science* that Mr. George Murray and Mr. V. H. Blackman have returned from their trip to Panama, after a successful and profitable voyage. They have obtained a large quantity of plankton containing many new specimens, which will shortly be worked out, and have made numerous interesting observations on living forms. They spent two or three days in Jamaica on the way.

PROFESSOR KOCH, so it is reported, is about to return to South Africa to carry out further experiments in relation to rinderpest.

PROFESSOR CHARLES S. PROSSER, of Union College, has been engaged during the past summer in mapping and describing the Upper Devonian formations of southeastern New York for the New York Geological Survey.

THE *Botanical Gazette* states that Drs. Farlow and Coulter will make, during the winter, a further examination in the West Indies with a view to finding a suitable site for a botanical tropical laboratory.

AN illustrated monthly of popular botany, *The Plant World*, will be published by Willard N. Clute & Co., Binghamton, N. Y., beginning October 1st. The editor is Dr. F. H. Knowlton, United States National Museum.

ON September 3rd Professor Nef gave a public address at the University of Chicago on 'The Problems of Organic Chemistry,' and on September 7th and 8th Professor Lester F. Ward was announced to give two lectures, one on 'The Founder of Sociology, Auguste Comte,' the other on 'Nature and Nurture.'

PROFESSOR SKLAREK, Halle, calls our attention to the fact that among the publications of the late W. Preyer, given on page 252 above, 'The Five Senses of Man' was included. The book is by Professor J. Bernstein, of Halle.

WE are glad to receive the information that 'The Louisiana Society of Naturalists' was organized on July 22d. The Society will not only undertake to encourage and advance the study of natural science, but will also establish a library and a museum, and will publish its proceedings. The Society is to be incorporated and starts with about 45 members, nearly all of whom are workers in some branch of natural science. The first officers are:

President, Professor J. H. Dillard, Tulane University; *Vice-Presidents*, Mr. G. R. Westfeldt, Professor H. A. Morgan, Louisiana State University, Rev. A. B. Langlois; *Secretary-Treasurer*, Mr. E. Foster; *Executive Committee*, Professor J. H. Dillard, Professor G. E. Beyer, Mr. G. R. Westfeld, Dr. O. Joachim, Professor H. A. Morgan, Mr. J. C. Smith, Rev. A. B. Langlois, Mr. E. Foster.

MR. H. C. FAIRBANKS, of Sibley College, while reconstructing a gas-engine, observed a singular though probably not exceptional phenomenon which, so far as known, has not been previously described. The machine exhibited a great loss of heater-efficiency, which was unaccounted for and was not affected by any changes made in the process of general repair. Finally it was suspected that the conductivity of the metal of the cast iron 'fire-pot' had been impaired by oxidation or otherwise, and it was replaced by a new one. The engine at once started off at full power and regained its original efficiency.

At the request of the daughters of George Bond, Professor Holden, Director of the Lick Observatory, has undertaken to arrange the manuscript material in their hands in an orderly form. The work will be entitled 'Memorials of William Cranch Bond, Director of the Harvard College Observatory, 1840–59, and of his Son, George Phillips Bond, Director of the Harvard College Observatory, 1859–65,' and will be sold for two dollars by C. A. Murdock &. Co., 532 Clay Street, San Francisco, and by Lemcke & Büchner, 812 Broadway, New York City. The contents are: Chapter I., Life of W. C. Bond, 1789–1859; II., Life of G. P. Bond, 1824–1865; III., Selections from the Diaries of George Bond; IV., Selections from the Correspondence of George Bond; V., Account of the Scientific Work of the Bonds; Appendices, giving a complete list of their published writings; and Index of Proper Names. The book will be well illustrated. It is hoped by the kindness of Professor E. C. Pickering, Director of the Harvard College Observatory, to reproduce two fine steel engravings of the Great Comet of 1858 and of the nebula of *Orion*, from the plates of the *Annals* H. C. O.

The British Museum (Natural History) has acquired, says *Natural Science*, the Savin collection of vertebrate remains from the Norfolk forest-bed and other deposits of that coast. A collection of gault fossils from the 300-feet level of the shaft of the Dover coal-fields has also been received, and it is understood that the whole of the remains from this very interesting and important shaft will be preserved for the national collections, as a typical reference series for the underground geology of the southeast of England.

UNIVERSITY AND EDUCATIONAL NEWS.

At the meeting of the corporation of Brown University on September 1st statements were presented by the Conference Committee and by President Andrews. He states that he has been reticent and careful in expressing views on the free coinage of silver by the United States; that he would discountenance any proposal which, in his judgment, bids fair to place the country's finances on a monetary basis of silver alone; that he has always insisted that the principal and interest of our public debt should be paid in gold, and that he had only publicly advocated that form of bimetallism which was a part of the Republican platform in the last election. He states further that his resignation was made on account of his desire to regard the University's interests and that the publication of the Committee's minutes did not proceed from his motion. As President Andrews simply cleared himself from the charges made by the Conference Committee and did not attempt to defend reasonable freedom of speech, we are especially glad that the corporation, in asking him to withdraw his resignation, stated that they did this "especially desiring to avoid, in the conduct of the University, the imputation even of the consideration of party questions, or of the dominance of any class, but that in the language of its charter, 'In this liberal and catholic institution all members whereof shall enjoy full, free, absolute and uninterrupted liberty of conscience,' which includes freedom of thought and expression, it cannot feel that the divergence of views upon the 'silver question' and of its effects upon the University between you and the members of the corporation is an adequate cause of separation between us." President Andrews has not yet made a reply to the letter from the corporation, but it is understood that he will not withdraw his resignation.

The executor of the will of the late Mrs. Lucy Fayerweather has brought suit in the United States Courts with a view to setting aside the decision of the State Courts awarding the estate of the late Daniel B. Fayerweather to the colleges to which it was bequeathed. The heirs-at-law are also contesting the will of the late William Lampson, who left most of his estate to Yale University, alleging that he was of unsound mind. We wish that the moral insanity which leads people to make these contests disqualified them at law from inheriting any money.

Dr. D. K. Pearson has presented Beloit college with a dormitory costing $30,000.

Yale University receives $5,000 by the will

of the late Miss Julia Lockwood for the foundation of a scholarship.

FUNDS given by friends of Smith College for a new dormitory will, it is said, be used for a chemical laboratory. It is hoped to secure some $30,000 for the building.

WE regret that the announcement made to the effect that Mr. S. B. Brownell had presented Barnard College with a building for a dormitory is incorrect. It had its origin probably in the fact that plans have been filed for the west wing of the new buildings of Barnard College, given by Mrs. Fiske, which will be temporarily used as a dormitory.

THE sixth annual summer school held at the University of Minnesota, Minneapolis, has just closed one of the most successful sessions of its history. The school is organized in two sections, an elementary section and a university section. The enrollment of the university section in the several scientific subjects was as follows:

General Chemistry; Professor Frankforter	40
Entomology; Mr. Oestlund	14
General Geology; Professor Hall	38
Physiology; Professor Nachtrieb	18
Plant Physiology; Mr. Ramaley	12
Physics; Professor Jones	30

AT the recent Zionist conference for the colonization of Palestine by the Jews at Bâle, a commission was appointed to report upon the establishment of a university at Jerusalem.

A SPECIAL commission will meet shortly at St. Petersburg to discuss the introduction of universal and compulsory education in Russia.

DISCUSSION AND CORRESPONDENCE.

OBSERVATIONS OF THE PASSAGE OF MIGRATING BIRDS ACROSS THE LUNAR DISK ON THE NIGHTS OF SEPTEMBER 23 AND 24, 1896.

THE time is at hand when records of the transit of migrating birds across the moon's face may be secured, and I desire to put on record the following measurements, made last year, which may be of assistance to observers. All records show that the migration takes place at night, at least in the case of the smaller birds, and the dates immediately preceding and following the full of the Moon, with probably a certain amount of latitude for weather and temperature, are the ones chosen.

The instrument used in these observations was the finder of the equatorial of the Ladd Observatory. Its aperture is 4 inches, and the magnifying power was 40 diameters. When focussed on the Moon, the eye-piece had to be pulled out 1.74 inches, and the principal focal length was 4 ft. 9.59 ins.

The observations may be divided into three groups:

a. 7:45 to 8:15 Eastern M. T., Sept. 23d.
b. 8:15 to 9:15 " " " "
c. 7:45 to 8:15 " " " 24th.

The apparent altitudes and azimuths of the Moon were:

Sept. 23, 7:45,	altitude =	19°.0,	azimuth	N. 88°.0 E.
" " 8:15,	"	24°.6,	"	S. 87°.1 E.
" " 9:15,	"	35°.4,	"	S. 76°.8 E.
Sept. 24, 7:45,	"	14°.6,	"	N. 79°.9 E.
" " 8:15,	"	19°.8,	"	N. 82°.3 E.

The mean altitudes were:

Period *a* (½ hour) 21°.8 above the true horizon.
b (1 hour) 30°.0 " " " "
c (½ hour) 17°.2 " " " "

Journal of Observations.

The flights were so rapid that it was thought best to attempt nothing more than hasty comparisons with prominent lunar features in order to get estimates of the apparent size of the birds. Three points were selected for this purpose:

Aristarchus (longer inside diam.) approximately	0′.3
Copernicus " " " "	0′.6
Mare Crisium " " " "	3′.0

Times were estimated by a chronometer audibly beating half seconds.

First night, September 23d. From 7:45 to 8:15 scarcely a minute passed without the passage of several birds, in groups numbering from one to five or six in immediate succession. It was obvious that the birds traveled in little companies. After perhaps a minute without any, one would appear, followed by four or five more in the next ten seconds—perhaps members of one family keeping near each other to relieve the loneliness of the long journey. The great majority traveled from north to south. Few deviated more than 20° or 30° from this

direction, and none were seen to move in the opposite direction. The majority were less than one-half second in crossing the Moon's disk (diameter = 29′.5). Quite a considerable number traversed the disk in 0.1 or 0.2 second. Few were as slow as 1 second and only one required 2 to 3 seconds. In this case the trajectory may have approached the line of sight. A majority appeared very small, not larger than Aristarchus (or 0′.3); few equaled Copernicus (or 0′.6); one only had a spread of wings equal to the longer diameter of the Mare Crisium (or 3′.0). In this case the wings were sharply seen when the focus was 0′.21 longer than the principal focal length. For most of the birds the focus scarcely required changing from that for the Moon's surface. Some of the swiftest flights were made by birds of the smallest apparent size.

After 8:15, as the moon rose higher (altitude 25° to 35°), the number of birds diminished; and at 9:15 intervals of 2 to 5 minutes elapsed between successive birds. The travelers no longer came in groups. Evidently the angular area of the Moon no longer filled the distance between the mean trajectories of the members of a group. The average size was larger, more nearly that of Copernicus; one bird, badly out of focus, equaled the Mare Crisium in size.

At 9:15 the observations were discontinued, as the intervals were continually getting longer.

Second night, September 24th. The watch was commenced at 7:45 with the Moon at a lower altitude than on the previous evening. The birds were less numerous, and after a half hour at 8:15, clouds began to gather, which soon completely covered the sky. In this half hour not over a dozen birds were seen. Two of these moved from south to north, traversing the diameter of the lunar disk in about 3 seconds. These were the only birds seen flying north on either evening, and the slowness of their speed indicates that they were probably moving more nearly in the line of sight (or east and west). Every flutter of the wings was plainly visible with the telescope at its lunar focus. One bird, of an expanse equal to that of the Mare Serenitatis, was blurred beyond recognition, and was evidently close at hand. One had the wavering flight of the goldfinch, and a diameter equaling that of Aristarchus (or 0.′3).

It seems possible that the prospect of cloudy weather may have deterred the migrating birds from starting on this evening. The interval from sunset to moonrise was also longer (48 minutes as against 24 minutes on the previous evening).

I now proceed to the reduction of these estimates, taking first the case of the single bird whose motion was slow enough to permit an exact adjustment of the focus, the focal length having to be increased for the bird from 57.59 inches to 57.80 inches. The bird was nearly end on. Assuming its real spread to have been 12 inches, and comparing its estimated angular diameter with the radius of a circle we have its

$$\text{distance} = \frac{3437.7}{3.0} = 1146 \text{ feet.}$$

Reversing the process, we have from the law of lenses,

$$\text{Conjugate focal length} = 1321 \text{ feet,}$$

which would make the spread

$$\frac{1321}{1146} + 12 = 13.8 \text{ inches.}$$

The spread of a robin is 16 inches, and the bird may have been of the size of a thrush.

The majority of the flights were at right angles to the line of sight, and the lengths of our smaller birds (warblers, flycatchers, etc.) being from 5 to 7 inches, I shall assume an average true size of 6 inches, and an apparent (angular) dimension of 0′.3 in periods *a* and *c*, with a mean altitude of 20°; while towards the close of period *b*, the altitude had increased to 35°, and the mean apparent angular diameter began to approach 0′.6. This gives for distances

$$\text{(a) and (c)} \quad \frac{3437.7}{0.3} \times \tfrac{1}{2} = 5729.5 \text{ feet,}$$

$$\text{(b)} \quad \frac{3437.7}{0.6} \times \tfrac{1}{2} = 2864.8 \text{ feet,}$$

and for the heights of the birds above the observer's level (235 feet above sea-level,

$$\text{(a) and (c)} \quad 5729.5 \times \sin 20° = 1959.6 \text{ feet,}$$

$$\text{(b)} \quad 2864.8 \times \sin 35° = 1643.2 \text{ feet.}$$

These measurements indicate an altitude of about 200 feet above sea-level as the average

height of the migratory flight of the smaller birds. Of course, if the dimensions were greater than those assumed, the altitudes must be correspondingly increased, but the largest bird, whose distance was determined by the focal adjustment already described, had an altitude above sea-level of

$$(1321 \times \sin 20°) + 235 = 687 \text{ feet},$$

and was certainly much lower than the smaller birds.

The speeds can be roughly estimated from the times of transversing the lunar diameter (29′.5). This time was on the average about one-half second, giving

$$\text{velocity} = \frac{29.5}{0.3} \times \tfrac{1}{2} \text{ ft. per } \tfrac{1}{2} \text{ sec.}$$
$$= 98.4 \text{ feet per second,}$$
$$= 67 \text{ miles per hour.}$$

But the swiftest flights, with every allowance for the difficulty of their estimation, were at least twice as rapid, which, if the distance were the same, would imply a velocity of at least 134 miles per hour. Some of the swifter trajectories may have belonged to very small birds at lower altitudes and smaller distances, but I have already assumed a size which is nearly that of our smallest birds. Any increase in the estimate of size enlarges that of distance and velocity. I am not ready to admit the probability of an error of judgment in the estimation of apparent sizes of as much as 100 per cent, and I have already increased the more vulnerable time-estimate for the swiftest flight from 0.15 to 0.25 seconds. Judging from the appearance of many of these darting specks, and with every allowance for errors of estimation, I am of the opinion that some of these apparent velocities are real, and that certain small birds (not the swifter swallows, humming birds and swifts, for these have all gone a month before the dates in question) can maintain a flight of 100 miles per hour without being stripped of their feathers.

In SCIENCE for January 1, 1897 (Vol. 5 N. S., p. 26), Mr. H. H. Clayton gives the height of a flock of ducks, flying southwest in December, as 958 feet above the Neponset valley, and the velocity as 47.8 miles per hour; and in SCIENCE for April 9, 1897 (Vol. 5 N. S., p. 585), the same observer gives the height for a flock of geese, migrating northeastward in March, as 905 feet above the Neponset valley, or 960 feet above sea-level, and the velocity of flight as 44.3 miles per hour. It thus appears probable that the larger birds migrate at a lower altitude than the smaller ones, and at not over half the speed of the swiftest flights.

Even more remarkable than the speed of migration are the psychological problems involved in these semi-annual movements of enormous multitudes of creatures. There was, to me, something awe-inspiring in this spectacle of a throng of tiny beings launching out into the unknown deep, in pale moonlight and through the hours commonly given to sleep, flitting swiftly and unerringly to a far-off goal, while beneath, and heeding them not, slumbered a dreaming world. What mighty impulse of daring is this which can transform a timorous sparrow, content all day to hop from bough to bough near to its nest and mate, into a bold adventurer, starting out, Columbus-like, on a voyage of discovery? If it were a matter of individual courage and wisdom, we men might shrink from the comparison—the ardor, the inerrancy, are so superhuman. Rather must we liken the migratory impulse to an irresistible force, drawing the winged wayfarers into its current, and bearing them they know not whither. It must not be forgotten that for the young birds, constituting no small number of the host, this journey is absolutely new, and not the result of experience. If the movement were the result of knowledge and trust, we might well exclaim: Oh to be as confident of eternal beneficence, and as full of foresight as are these little wanderers!

FRANK W. VERY.

LADD OBSERVATORY,
PROVIDENCE, R. I., September 3, 1897.

SCIENTIFIC LITERATURE.

Year-book of the United States Department of Agriculture, 1896. [1897.]

In the preface to this volume, Mr. Charles W. Dabney, Jr., remarks that it falls far short of the ideal set for it, and regrets that it was not possible to give it more 'editorial revision' than it has received. We may all hope with

Mr. Dabney that each year-book will be better than its predecessors; but it seems to us that there is nothing to apologize for in the present work; and as for 'editorial revision,' we believe the mostly eminent writers of the articles it contains know perfectly well what they are about, and that revision of any sort would be an injury to them and a detriment to the volume. It is the proper work of the editor to obtain, select and arrange suitable articles for the volume, and this Mr. Dabney has done in a most admirable manner; but the time has come for scientific workers to insist on having their manuscripts printed as written, instead of being changed and even interlarded with gross errors, as is sometimes the case.*

The frontispiece of the year-book appropriately consists of the portraits of Senator Morrill and Hon. Wm. H. Hatch; the fine face of Senator Morrill is especially welcome, and will not easily be forgotten, even by those who have only seen the picture. The first part of the book, the report of Secretary Morton, has long been before the public, and need not be specially discussed now. It is, however, a document that should be read by all who take any interest in agriculture or agricultural science. The observations on the free distribution of seeds, and on the affairs of the experiment stations, will be endorsed by nearly all those who are not connected with the 'political machine.' Whatever opinion one may hold as to the propriety of the free distribution of seeds by the government, the present system must be condemned as wasteful and unjust. Whatever views one may have as to the desirability of local control, it cannot be permitted for experiment station authorities to break the letter or the spirit of the law, or waste the funds entrusted to them. The people of the United States, after all, are partners in business, and cannot wholly escape responsibility for one another's actions. It is, besides, a serious injury to the majority of stations, which are admirably applying their funds, that the minority should be able to drag the name of the experiment stations in the mud.

The body of the book consists of thirty articles bearing on as many problems of agriculture and kindred arts, and while probably no living person is competent to sit in critical judgment on such a varied assortment, it will not be questioned that each essay is of great value. We think that any educated citizen of this country, turning over the pages, cannot fail to feel very proud of the volume, as affording evidence of the highly satisfactory condition of at least one of the great departments of the government. If he is acquainted with the official agricultural publications of other countries he will have the further satisfaction of knowing that the United States is leading, not following, in the matter of educating the agricultural population, for the year-book is as truly an instrument of education as any college or university.

Mr. H. J. Webber's article on the 'Influence of Environment in the Origination of Plant Varieties' is very interesting, though he does not directly meet the question whether acquired characters are transmissible, while apparently being of that opinion. Dr. C. W. Stiles' essay on 'The Country Slaughterhouse as a Factor in the Spread of Disease' is very opportune. Mr. Marlatt's 'Insect Control in California' is an extremely valuable article and will help to settle some hot disputes between entomologists and horticulturists. 'The Superior Value of Larger Heavy seed,' by Messrs. G. H. Hicks and J.C. Dabney, is not only of much practical value, but of considerable theoretical interest. It is impossible now to discuss the remaining articles, but special attention must be called to 'An Ideal Department of Agriculture and Industries,' by M. E. Tisserand, Councillor of State and Director of Agriculture in France. This is a most suggestive and interesting article, and we should express our thanks to Mr. Dabney for arranging for its publication in the year-book.

T. D. A. Cockerell.

Mesilla, N. M.,
August 10, 1897.

* Some readers will think this too strong a statement, but we could readily give the facts of the cases we have in mind. It may be added that those responsible for the errors were scientific experts of excellent standing, as learned as any that could be obtained, but they did not happen to know everything. The publications were not those of the Department of Agriculture.